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SIXTH ANNUAL REPORT

OF THE

COMMISSIONERS

OF THE

MAR 28 1890

State Reservation at Niagara

FOR THE FISCAL YEAR

From October, 1888, to September 30, 1889.

TRANSMITTED TO THE LEGISLATURE JANUARY 22, 1890.

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With the Compliments of

ANDREW H. GREEN, Pres't, JAMES MOONEY,
JOHN HODGE, JOHN M. BOWERS
and DANIEL BATCHELOR,

Commissioners of the State Reservation at Niagara.

HENRY E. GREGORY, Treasurer & Secretary,
214 BROADWAY, NEW YORK.



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COMMISSIONERS.

ANDREW H. GREEN, *President.*

JAMES MOONEY.
JOHN M. BOWERS.

JOHN HODGE.
DANIEL BATCHELOR.

TREASURER AND SECRETARY.

HENRY E. GREGORY.

SUPERINTENDENT.

THOMAS V. WELCH.

STATE OF NEW YORK.

No. 23.

IN ASSEMBLY,

JANUARY 22, 1890.

SIXTH ANNUAL REPORT

OF THE

COMMISSIONERS OF THE STATE RESERVATION AT
NIAGARA, FOR THE FISCAL YEAR, FROM OCTOBER
1, 1888, TO SEPTEMBER 30, 1889.

To the Honorable the Legislature:

The Commissioners of the State Reservation at Niagara, as required by law, submit their annual report for the fiscal year from October 1, 1888, to September 30, 1889.

Their last annual report contained a summary statement to the effect that the buildings and other objects which had for years been permitted to deface the landscape at Niagara had been removed from the territory of the Reservation. This preparatory work having been accomplished, it seemed to be the duty of the Commissioners to proceed to do that for which chiefly they were constituted a State Board, to wit: To restore the scenery of the Falls of Niagara to its natural condition and to preserve it from possible injury and violation as

long as it should remain under their care and subject to their control.

The Legislature, it may fairly be assumed, recognized the fact that the preliminary labors of the Commissioners had been performed, for in 1887 it enacted, by chapter 656, that the Commissioners "shall have power to *lay out*, manage and maintain said Reservation." By the same act the sum of \$20,000 was appropriated for the care and maintenance of the Reservation; but no money was granted for the purpose of laying out the grounds and of restoring the scenery of the Falls to its natural condition. This omission delayed for one year the work of restoration.

The Legislature, in 1888, likewise appropriated \$20,000 for care and maintenance; but, following the example of its predecessors, omitted any provision for the essential work of restoration and improvement.

By chapter 569, Laws of 1889, the Legislature increased the annual sum for maintenance to \$25,000; but passed an act fixing the pay of State laborers at not less than two dollars a day, and of those employed otherwise than day laborers at a rate of not less than twenty-five cents per hour. This increase of wages and salaries renders it impossible to accomplish with \$25,000 any more than was formerly done with \$20,000.

By chapter 570, the Legislature this year granted the Commissioners the sum of \$15,000 "for repairs of roads, bridges and betterments on the Reservation," and the State Engineer and Surveyor was "authorized to make such surveys and maps, and to set such monuments, as may be requested of him by the said Commissioners."

This may be said to be the initial expression of legislative willingness to aid the Commissioners in their

efforts to fulfill the purposes for which they were appointed. The work of restoration might have been undertaken earlier had the Legislature deemed it wise to provide the necessary funds. During the last two years much work of a substantial and permanent character might have been done, and the scenery about the Falls would by this time have presented increased attractions.

The comprehensive plan of restoration which the Commissioners desire to carry out will require moderate annual appropriations for some years to come. The work which has been so long postponed should now be pushed forward with as much rapidity as the nature of it will permit.

Former reports have contained statements concerning expenditures which the Commissioners considered especially important.

In the last report reference was made to the indifferent condition of the walks and roads within the Reservation, and particularly to those on Goat Island. The Commissioners requested an appropriation for the reconstruction of the existing Goat Island roads and for laying out and constructing new and better ones. They are still of the opinion that measures should be speedily undertaken to provide good and substantial walks and roads at Niagara.

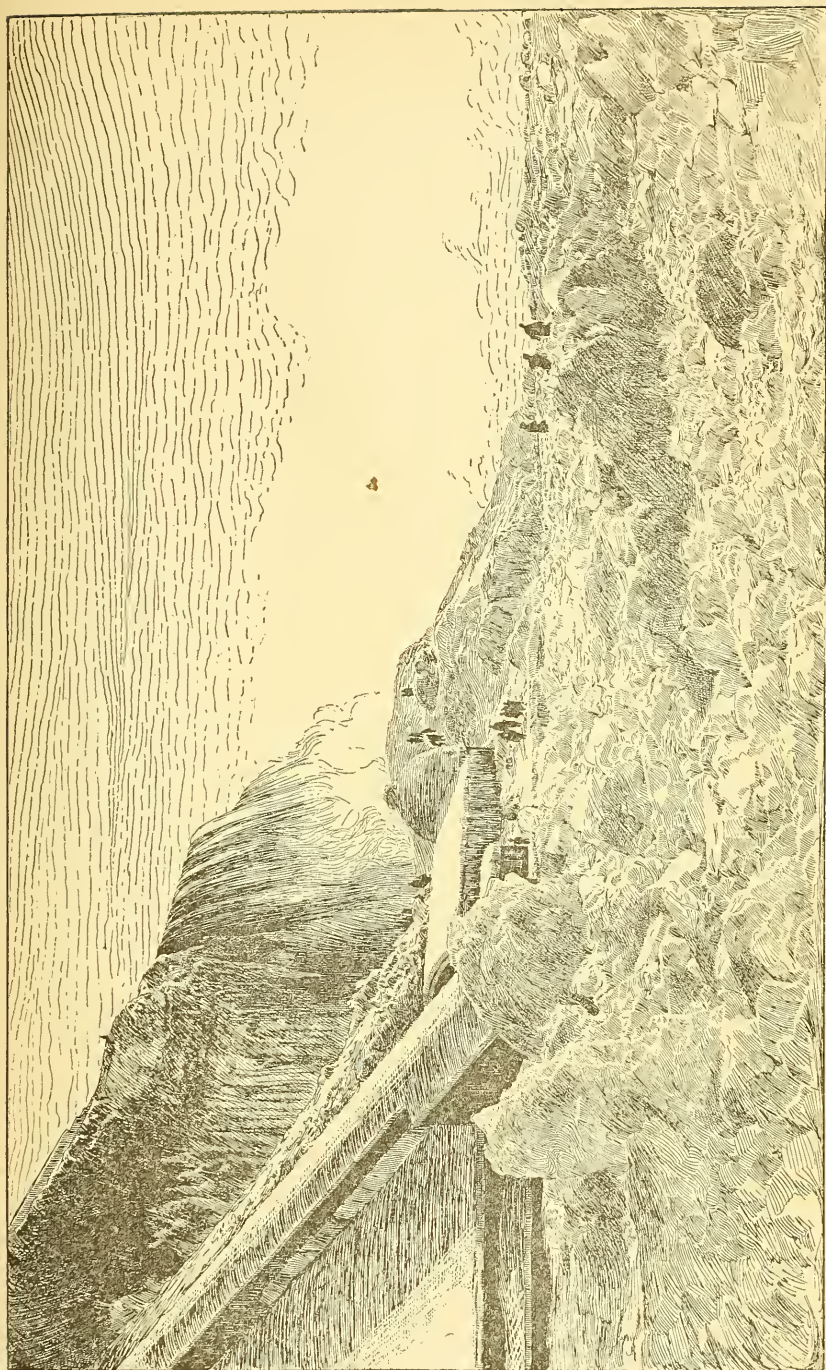
By far the greatest enjoyment of a visit to the Falls is obtained in the course of a leisurely walk. The saunterer at Niagara derives far more satisfaction from a sojourn there than one who takes all his sight-seeing seated in a carriage. Indeed, it is impossible, except on foot, thoroughly to see the principal charms of the Niagara scenery. Walking, nevertheless, is objectionable to large numbers of visitors, and they who decide to

make the circuit of Niagara in carriages should be enabled to do so comfortably. Smooth and solid roads are a necessity. Portions of the roads on Goat Island are so thickly shaded by the primitive forest that mud remains upon them, deep and black, long after the rain has ceased, to the obstruction of vehicles and the discomfort of visitors.

Among the first essentials of a public pleasure ground are goods walks and roads. However sublime the natural scenery within its limits, however perfect its artificial adornments, they will not prove in the highest degree attractive to the people, unless access to them is both easy and inviting. While the Niagara Reservation is not a park, in the commonly accepted sense of the word, it will be generally agreed that, since it includes within its borders the stupendous cataract whose power, grandeur and beauty have thrilled the souls and awed the minds of men of all sorts and conditions, from the savages of the Iroquois and the Neutral Nation to the poets and philosophers of the most civilized countries—it will be generally agreed that here, if anywhere, means of access to the principal points of view should be convenient and agreeable.

There is but one Niagara. The traveler who fails to include the great cataract in his itinerary is sure to regret it. The State, having assumed the ownership of the land about the Falls, invites all people to come and visit its most wonderful possession. To make adequate provision for the comfort and convenience of his guests is the duty of an enlightened host. It would hardly be deemed extravagant to take the requisite measures to prevent annoyances to visitors while on the domain of the State, or to render the many points

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THE ICE BRIDGE.

of natural attractiveness accessible by sufficient roads, bridges, walks and resting-places.

A view upward from the foot of the Falls can only be had after having made a descent of nearly 200 feet. Many, who do not count themselves weak, hesitate to undertake the trip. Thousands, however, desire so to do.

The simple facilities afforded by an elevator to be operated by the force of the water, whereby a safe transit may be made by the aged and weak as well as by the strong and robust, at a nominal charge, merely sufficient to pay the operating expenses, would be a public convenience by which thousands would be enabled to witness some of the most attractive views of the Falls.

For those who prefer, however, to make the descent on foot, there should be a stairway free of charge to everybody.

Inasmuch as the annoyances, impositions and abuses most frequently complained of at Niagara arise between visitors and the drivers of public conveyances, it seems wise and in the interest of the traveling public to make the exercise of walking on the Reservation as attractive as possible.

It is important to be kept in mind that outside of the limits of the Reservation the Commissioners have no authority to prevent impositions or protect visitors from injustice.

The restoration of the sloping bank of the river from the Grove to Bridge street, as has been pointed out in previous reports, should no longer be delayed. It was formerly very largely covered by buildings. These having been removed, the surface, of course, presents an irregular, mutilated and barren appearance. Grading and filling to a limited extent have somewhat relieved the

ugliness of the contour of the surface here. But much remains to be done. Turf and trees are especially needed.

In the selection of young trees and in the arrangement of them, special knowledge and taste will be sought by the Commissioners. Years must necessarily elapse before the plantations can attain the growth required for the concealment of the village structures that border on the Reservation. This portion of the mainland is particularly mentioned because it is near the Falls and in close proximity to the main entrances to the Reservation. The bank of the river for a considerable distance beyond Bridge street likewise needs to be graded and planted.

It should be said that, in view of the necessity that exists for the planting of portions of the Reservation, it seems advisable to establish a nursery to provide the trees that will be needed. A small and secluded part of Goat Island may properly be used for this purpose.

The bridges of the Reservation, although at present in a safe condition, are mainly of wood and demand frequent repairs. They can not be regarded as permanent structures. Periodical inspections are required to satisfy the Commissioners that they are fit and safe for the use of the public. Sooner or later, one by one, they must be replaced by structures of iron, steel or stone.

The foot-bridge that connects Goat Island with Luna Island is but an inferior affair. A stone or iron bridge placed a few rods back from the brink of the Falls should, as early as practicable, be constructed.

The importance of protecting the southern shore of Goat Island from the action of the river, was brought to the attention of the Legislature in the last annual report, as well as in that of 1887. It is hardly necessary

to state that, during the past year, owing to lack of funds, no measures of a permanent character have been adopted to prevent this abrasion of Goat Island. Meantime, the current with unabated force carries on its devastating work. While there are no means of ascertaining exactly how much of the soil of Goat Island is annually worn or washed away, there can be no doubt that the process of destruction goes incessantly on. The river dashes against the island with enormous force and velocity. It has a descent of about fifty feet in the last mile of its course to the brink of the precipice. An island of granite would inevitably yield to the eroding power of such an irresistible current.

Goat Island is so valuable and so beautiful that any diminution of its size is to be regretted as a loss that can not be replaced. Ownership imposes obligations, and one of these is to see to it that the property of the State suffers no injury by reason of neglect on the part of those who are invested with authority and its accompanying responsibility.

During the great storm of January, 1889, when the river was much swollen and the force of the current increased, the erosive energy was considerably augmented and the amount of damage noticeably greater. Nor did the mainland escape. There was some washing of the soil near the old French landing. The smaller islands also suffered. The tumultuous torrent flowed over the bridge between the first and second Sister Islands, as well as over parts of each of these islands. The injury wrought by this mass of rushing water was quite serious. Portions of the surface soil were washed away, leaving the rock exposed. Trees and shrubs were prostrated or swept away. A section of the pier at the head of the

race-way by which water is conducted to the Inclined Railway was carried away. The fence and sidewalk along the Rapids between the Grove and the bridge to Bath Island were forced out of place up on the bank. The water in the river below the Falls rose over twenty feet, causing much damage to the dock of the "Maid of the Mist." In the Grove and on Goat Island many trees were blown down.

The Niagara, it has been said, drains half a continent. Between its banks pours the overflow of all the great lakes, except Lake Ontario.

The following extracts are from a paper prepared by Assistant Engineer L. Y. Schermerhorn and given in notes explanatory of Crosman's Chart of the Great Lakes:

"The lately completed lake surveys, made by the United States, have reduced to exactness much that previously was only approximate, and the perfection of methods used gives a perfection to the results which seldom obtains in surveys covering so great geographical extent and involving so many details.

"The water surface of the Great Lakes with the land draining into it presents a total drainage basin of over 270,000 square miles, assembled as follows :

	Area of watersurface. Square miles.	Area of water-shed. Square miles.	Aggregate area of basin. Square miles.
Lake Superior... ..	31,200	51,600	82,800
St. Mary's river... ..	150	800	950
Lake Michigan... ..	22,450	37,700	60,150
Lake Huron and Georgian bay.	23,800	31,700	55,500
St. Clair river... ..	25	3,800	3,825
Lake St. Clair... ..	410	3,400	3,810
Detroit river... ..	25	1,200	1,225
Lake Erie... ..	9,960	22,700	32,660
Niagara river... ..	15	300	315
Lake Ontario... ..	7,240	21,600	28,840
	95,275	174,800	270,075

“The water surface of Lake Superior nearly equals the combined areas of New Hampshire, Vermont, Massachusetts and Connecticut; Lakes Michigan and Huron together nearly equal the area of the State of New York, Lake Erie, the combined areas of New Jersey and Delaware and Lake Ontario, about three-fourths of the area of Maryland. The combined area of the lakes exceeds the area of England, Wales and Scotland. * * *

“The recently perfected levels of the United States Lake Surveys, between tide water and the lakes, fixes the elevation of their mean surfaces above mean sea level as follows :

	Feet.
Lake Ontario.....	246 $\frac{6}{10}$
Lake Erie.....	572 $\frac{9}{10}$
Lakes Huron and Michigan.....	581 $\frac{3}{10}$
Lake Superior.....	601 $\frac{8}{10}$

“The difference of twenty and one-half feet between Lakes Superior and Huron occurs in the rapids of St. Mary’s river ; the eight and four-tenths feet between Lakes Huron and Erie, mainly in Detroit river.

“The difference of 326 feet between Lakes Erie and Ontario occurs in the vicinity of Niagara Falls, and is principally assembled as follows : One hundred feet in the five miles of rapids between Lewiston and the lower Suspension Bridge ; ten feet in the rapids between the bridge and the Falls ; 160 feet at the Falls ; fifty feet in the rapids immediately above the Falls, and six feet in the upper Niagara river.

“The mean depth of Lake Superior is about 475 feet ; the deepest point marks a depth of 1,008 feet, or 406 feet below the level of the sea. Lake Huron has a mean depth of about 250 and a maximum depth of 750 feet. Lake Michigan has a mean depth of 325 feet and a maximum depth of 870 feet. Lake Erie is comparatively shallow, having an average depth of less than seventy feet, and a maximum of 210 feet. Lake Ontario has a mean depth of about 300 feet, and a maximum of 738, or nearly 500 feet below the level of the sea. The channels of the rivers connecting the lakes seldom exceed the depth of fifty feet. If the lakes could be drained to the level of the sea, Lake Erie would disappear, Lake Huron reduced to quite insignificant dimensions, Lake Michigan to a length of about 100 miles, with a width of twenty-five or thirty miles, Lakes Ontario and Superior, although with

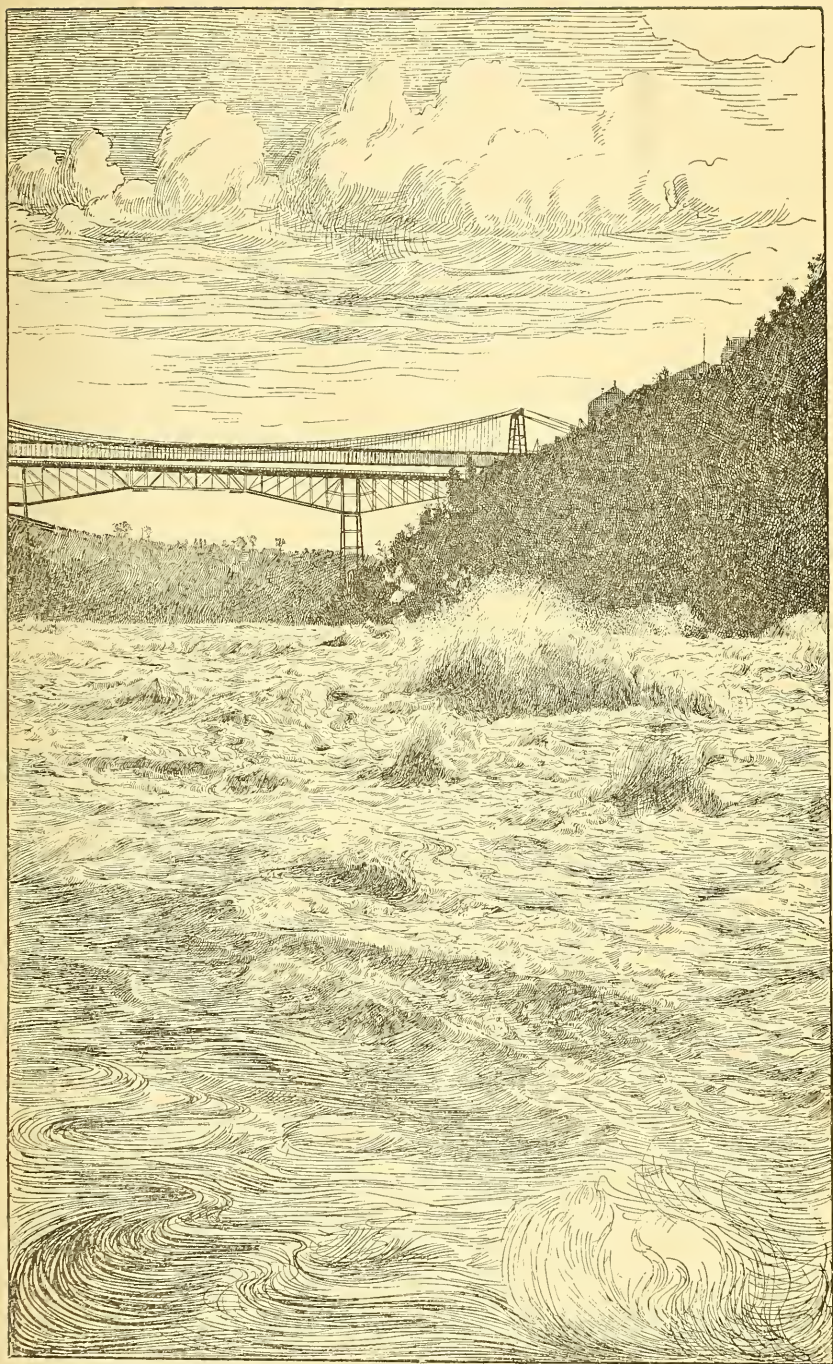
diminished areas, would still preserve the dignity of their present titles as *Great Lakes*. * * * *

"The following represent the average discharges at the outlets of the lakes : Lake Superior, at St. Mary's river, 86,000 cubic feet per second ; Lakes Michigan and Huron, at St. Clair river, 225,000 cubic feet per second ; Lake Erie, at Niagara, 265,000 cubic feet per second ; Lake Ontario, at St. Lawrence river, 300,000 cubic feet per second.

"The aggregate discharge of the lakes is double that of the Ohio and nearly equals half the discharge of the Mississippi. The area of the lake basin is a third larger than the basin of the Ohio, or about a fifth the combined areas of the basins of the Mississippi and its affluents. The outflow of the lake basin is slightly less than half the rainfall, while on the Mississippi and Ohio the discharge is about a fourth the rainfall. If the average discharge of the lakes passed through a river one mile wide with a mean velocity of one mile per hour, such a river would have a depth of forty feet from shore to shore.

"The volume of water in the lakes is about 6,000 cubic miles, of which Lake Superior contains a little less than one-half. Perhaps a better idea of this volume may be obtained when it is said that it would sustain Niagara Falls in its present condition for about 100 *years*."

In March, 1889, there was introduced into both Houses of the Legislature a bill entitled "An act to authorize the Niagara Hydraulic Electric Company to erect machinery under Niagara Falls for the purpose of utilizing the water power of said Falls for manufacturing electricity and to erect the necessary machinery for the same." It was referred to the Judiciary Committee in the Senate, and to the Committee on Internal Affairs in the Assembly. On April third the President of the Board sent a letter to the Legislature, under cover to the Speaker, in which objections to the measure were stated. On April fourth a similar letter was addressed to the Chairman of the Assembly Committee on Internal Affairs, and on April fifth, a letter to the Chairman of the Senate Committee



THE WHIRLPOOL RAPIDS.

on Finance, also aimed against the same measure. Copies of these communications are printed in the appendix to this report.

Notwithstanding these remonstrances the bill was reported favorably in both Houses. On May seventh it came up in the regular order in the Senate. On motion of Senator Walker it was, by a vote of 19 to 11, recommended to the Judiciary Committee, and so disposed of for the session.

The Commissioners conceived it to be their duty to oppose the passage of the bill, inasmuch as its provisions were in direct contravention of the purposes for which the lands of the Reservation had been taken by the State for the public use. The company asked to be permitted to turn aside the water where it rolls over the precipice at Prospect Park; then, by blasting, to construct a vault or cave in the rock and behind the Fall. Here it proposed to place dynamos to be operated by water descending through a tube or well upon turbine wheels. Should the company be allowed to undertake operations as here indicated, the Falls and the scenery would be permanently defaced, and a precedent established that would be followed by deplorable consequences. The Commissioners hope that the general condemnation which this extraordinary and presumptuous project received will effectually discourage other persons from seeking to secure legislative sanction for similar undertakings.

It may as well be understood that the Commissioners will decline to entertain propositions or applications, on the part of individuals or corporations, to utilize the water power at Niagara; nor will they countenance any scheme or project the success of which would be likely to result in defacement of the landscape, or in any way

interfere with the performance of the duty intrusted to them, namely, that of restoring the scenery to its natural condition. No contrivances for private pecuniary profit, no advertising devices will be allowed on the Reservation.

During the year eight pairs of iron needle beams have been placed in the main bridges. Five pairs had previously been inserted. The strength and security of the bridges are thus increased. A wrought iron pipe or conduit has been substituted in place of the old wooden one by which water was supplied to the Inclined Railway. The machinery in the wheel-pit of the Inclined Railway has been examined and repaired. A new manilla cable has been placed in position on the railway. The wooden stairway and walk to the Terrapin rocks have been removed and new and enlarged ones substituted. The charts of the United States Lake Survey, which were presented to the Commissioners, have been hung in the library.

The library, it should be understood, is a frame building in Prospect Park already there when the State acquired possession. It has been allowed to remain, as an appropriate depository for charts, maps and books that may be donated to the State.

A folding guide, in cheap form, including a map of the Reservation and vicinity, has been prepared under the direction of the President of the Board. This is designed to furnish all necessary information to visitors, such as directions as to the way of reaching the points of view within the Reservation, together with carriage rates, other items of expense and suggestions of interest.

The New York Central and Hudson River Railroad Company issued, during the year, what purported to be a guide to Niagara. It, however, contained many erro-

neous statements. The President of the Board having directed the attention of the company to these errors, assurance has been received that they will be corrected.

The number of visitors to the Reservation during the year has been somewhat smaller than last year. The sensational and foolhardy performances which have been described in the public prints since the submission of the last report have taken place, if at all, outside of the jurisdiction of the Commissioners.

The monthly receipts from the Inclined Railway were as follows:

1888.	
October	\$229 30
November	84 10
December	20 25
1889.	
January	49 05
February	13 05
March	58 55
April	84 20
May	242 00
June	423 85
July	1,042 85
August	1,888 90
September	938 00
	\$5,074 10

At the beginning of each month during the year, the total receipts and earnings of the Reservation for the month immediately preceding have been transmitted to the State Treasurer. Interest on balances in bank at three per cent has been remitted to the same official quarterly.

The Comptroller has honored a requisition made quarterly upon him for a fourth part of \$20,000 appropriated

for the care and maintenance of the Reservation by chapter 270, Laws of 1888.

The treasurer's report herewith submitted contains a statement in detail of all receipts and expenditures for the fiscal year ended September 30, 1889, of which the following is a summary:

Balance September 30, 1888.....	\$23 46
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RECEIPTS.

Inclined Railway.....	\$5,074 10	
Rentals	2,135 00	
Sales	37 95	
Interest	111 58	
		7,358 63
From State Treasurer.....		20,000 00
Total		\$27,382 09

DISBURSEMENTS.

Pay-rolls at Niagara	\$11,207 44	
Labor, materials, etc	6,842 23	
Commissioners and treasurer, traveling expenses, etc.....	1,482 97	
Total	\$19,532 64	
Remitted to State Treasurer	\$7,358 63	
Interest of previous year, ...	35 14	
		7,393 77
		26,926 41

Balance September 30, 1889.....	\$455 68
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Total receipts since organization of the Commission	
June 9, 1883.....	\$109,781 10
Total disbursements.....	109,325 42

Balance	\$455 68
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The following is "an estimate of the work necessary to be done and of the expenses of maintaining said Reservation for the ensuing fiscal year," ending with September 30, 1890.

MAINTENANCE.

Salaries, office and traveling expenses.....	\$4,300
Reservation police, watchmen, etc.....	5,700
Mechanics and laborers.....	7,000
Materials, tools, trees, etc.....	7,000
Miscellaneous	1,000
Total	<u>\$25,000</u>

IMPROVEMENTS.

Repairs of roads, filling, grading, planting, etc.....	\$25,000
For an hydraulic elevator.....	35,000
For bridges, repairs, etc	5,000
For iron railing on Goat Island, etc	1,500
	<u>\$66,500</u>

ESTIMATED RECEIPTS FROM OCTOBER 1, 1889, TO SEPTEMBER 30, 1890.

Inclined Railway	\$6,000
Cave of the Winds.....	1,200
Ferry and steamboat landing.....	500
Carriage service.....	100
Baggage-room	50
Total	<u>\$7,850</u>

An able and interesting essay by Prof. G. K. Gilbert, of Washington, D. C., on the history of the Niagara river is appended to this report.

In the report of the superintendent, hereto annexed, will be found details of the work of the year.

ANDW. H. GREEN,
JAMES MOONEY,
JOHN HODGE,
JOHN M. BOWERS,
DANIEL BATCHELOR,

Commissioners of the State Reservation at Niagara.

HENRY E. GREGORY, *Secretary.*

REPORT OF THE SUPERINTENDENT
OF THE
STATE RESERVATION AT NIAGARA
FOR THE
Fiscal Year Ending September 30, 1889.

REPORT OF THE SUPERINTENDENT.

To the Board of Commissioners of the

State Reservation at Niagara:

GENTLEMEN.—I respectfully submit the annual report of the superintendent.

During the fiscal year ending September 30, 1889, the affairs of the State Reservation at Niagara have been carried on, without serious difficulty. The number of tourists visiting the Reservation has increased, while the number of excursionists from neighboring localities, has not been so great as in other years. Although upon occasions, visitors from various localities, exceeding 5,000 in number, have been present on the same day, no disorder has been manifest, and notwithstanding the many dangerous places, no accident has occurred, within the Reservation, during the year. Owing to the constant passing in and out of visitors, no accurate account of the number can be obtained. Observation extending over the period which has elapsed since the establishment of the Reservation and comparison with the registered number of visitors to the Queen Victoria Niagara Falls Park confirm the impression that 500,000 visitors to the Reservation per annum, is not an excessive estimate.

Assuming 500,000 visitors per annum, to be a fair estimate, and that there has been saved to each the amount of the tolls formerly charged upon the grounds, now included within the Reservation, to wit: Fifty cents admission to the Islands, twenty-five cents admission to Prospect Park, and twenty-five cents for the use of the stairway at the Inclined Railway in Prospect Park, aggregating one dollar for each visitor, there has been at this time saved to the public the amount paid by the State, for the lands included within the State Reservation at Niagara, and the cost of maintenance up to the present time.

An examination of the statement of the number of excursionists, hereto appended, aggregating 142,860 persons, shows that a very

large proportion of the visitors to the Reservation are residents of the State of New York.

The revenue from the Inclined Railway and leases, amounted to nearly one-half as much as the total expenditures by the superintendent. If to the present sources of revenue, were added a much needed elevator, for ascending and descending the cliff between the American and the Horseshoe Falls, on Goat Island, operated by the State like the Inclined Railway for a nominal charge, and having a free stairway attached, the aggregate revenue from the Inclined Railway, and a suitable elevator, would go far towards paying the annual cost of maintenance.

The necessity of a commodious elevator, to take the place of the Biddle Stairway at the Cave of the Winds, has been commented upon in former reports of the superintendent. Visitors to the Reservation, desire to obtain the view to be had from the base of the cliff on Goat Island, between the American and the Horseshoe Falls. The great drawback to the enjoyment of visitors at this point is the labor of descending and ascending a narrow winding stairway eighty feet in height. The structure is old and unsuitable for the accommodation of the number of persons who desire to see the Falls from this favorable point of view. The debris slope under the cliff between the American and Horseshoe Falls commands unrivaled views of the cataract. It is the central point from which the magnificent scenery on either hand may be viewed to advantage. Near the edge of the water a walk of a quarter of a mile in extent can be constructed from the American to the Horse-shoe Falls. Such a footway would be as free from danger as the walk from the steamboat landing to the base of the American Fall at Prospect Park, which is now visited by more than 100,000 people each year. The general public are practically debarred from the enjoyment of the views of the scenery to be obtained from the slope between the two Falls, for want of proper facilities for descending and ascending. An hydraulic elevator could be operated to advantage in the locality. An elevator would be more safe and sightly than the present structure, and would not only be a means of great enjoyment to the public, but a sure and unobjectionable source of revenue to the State.

THE STORM OF JANUARY 9, 1889.

The severe storm of January ninth, caused considerable damage to the Reservation. The principal damage is the largely increased erosion upon the southern shore of Goat Island. The island is mainly a deposit of gravel upon the Niagara limestone which forms the bed of the river. The soil varies in thickness from forty feet at the western margin to a thin wedge at the eastern end of the island where the rock comes to the surface. The eastern and southern margins of Goat Island are rock-bound; the western margin is a steep, rocky bluff. Along the southern margin the bed of the island is composed of layers of gravel, clay, gravel, quicksand and gravel, downward from the surface in the order named. Ordinarily the water in the river does not rise above the lower layer of gravel, which averages about two feet in thickness. During the storm of January ninth and tenth last, the wind forced the water of Lake Erie, through the outlet of the lake, into the Niagara river in such quantity as to raise the level of the river above the Falls four feet, reaching the bed of quicksand on the southern shore of Goat Island, which offered little resistance to the force of the water. Where the southwestern portion of the island juts out into the river the swollen current washed away about ten feet of the bed of the island for a distance of 300 feet, and increased the already existing erosions at various points along the southern shore. In some places the washing away of the shore caused the embankment to cave in, undermining the foot-path, necessitating its abandonment at such points and the construction of a guardrail for public safety. At the first place of erosion, just below the Three Sisters Islands, the foot-path has caved in and the erosion impinges upon the driveway. The southern shore of Goat Island, viewed from the Three Sisters Islands, now presents in many places a raw, perpendicular bank, where formerly there was an inclined surface, partially covered by vegetation.

The tendency of the current is to wash away the southwestern portion of the island which curves outwardly into the rapids. A number of deflecting piers of logs and stone have been constructed to protect the shore from the force of the water and the

large masses of ice floating in the river at times during the spring and winter months. The existing piers are inadequate and if the bank of the island is to be properly guarded the piers will require to be replaced by means of protection more continuous and substantial.

It is stated that a storm, similar to that of January ninth and tenth, occurring in the year 1847, entirely washed away Gull Island, about two acres in extent. Gull Island was situated south of Goat Island and just above the Horseshoe Falls.

At the times of very high water the group of the Three Sisters Islands obstructs the water in the river, causing it to rise above those islands to a higher level than in other places in the river. During the storm of January ninth the water covered a portion of the First Sister Island, the ends of the bridge between the First and Second Sisters Islands and flowed over the Second Sister Island, doing considerable damage to the surface. The upper end of the Third Sister Island was submerged and the soil and vegetation carried away from that locality, leaving the rocks bare to a much greater extent than formerly and overturning a number of trees at the margin of the island.

Many trees upon the Reservation were destroyed by the gale. Upon the islands fifty-nine (59) trees were blown down, as follows: Ten basswood, five birch, seven maple, three elm, eight white cedar, eleven red cedar, seven pine, three ironwood, one hemlock, one white oak, one black ash, one hickory, one buttonwood. In Prospect Park seventeen (17) trees were overturned, as follows: Four white cedar, two red cedar, one hickory, four basswood, two box alder, three ironwood, one pine. Along the river bank two (2) willows were blown down. Two-thirds of the trees were living and ranged mainly from six to thirty inches in diameter. A buttonwood on Goat Island, five feet in diameter, the largest tree upon the Reservation, was prostrated. By reason of the mild winter the ground was almost free from frost and in its soft and wet state afforded little resistance to the force of the wind upon the trees.

Upon Goat Island there is an abundant young growth to take the place of the trees destroyed, but in Prospect Park and along the river bank, on the mainland, the necessity for fresh planting,

to repair the losses sustained at times from storms and the constant decay of the older trees, can not be too urgently presented.

On the mainland the high water washed away a portion of the made land at the "Old French Landing," at the eastern terminus of the Reservation, and a large portion of the pier at the head of the raceway which furnishes water for the operation of the Inclined Railway. The repair of the damaged pier would be attended by considerable expense. The new iron conduit supplies water more freely than the wooden box formerly in use, and at present there is abundant water for the operation of the Inclined Railway, excepting at seasons of floating ice. As the laying of a pipe in the raceway for a water supply has been mentioned the reconstruction of the pier may be held in abeyance for the present, if desired.

Below the Falls the water in the river rose twenty-four (24) feet, being four feet deep in the waiting-room at the foot of the Inclined Railway and endangering the railway building, from which the large front windows were blown by the gale. The building erected for shelter upon the dock at the steamboat landing was unroofed, an out-house in the same locality carried away and a summer house in Prospect Park blown down.

The bridges upon the Reservation were not injured by the wind or high water during the storm. If ice had been floating in the river, as is frequently the case in the month of January, it is probable that some of the bridges to the smaller islands would have been destroyed.

BRIDGES.

Eight pairs of iron needle beams have been placed in the bridges between the mainland and Goat Island.

The planking of the main bridge, from the shore to Bath Island, has been renewed, the joists doubled in number by the addition of oak stringers, new approaches of plank made at the ends of the bridge and one of the piers of the bridge filled with stone and the cribbing repaired.

The new planking extends from center to center of the main truss rods, thereby widening and improving the appearance of the roadway of the bridge. The roof of the bridge gate-house has also been repaired and the structure repainted.

The needle beams of the bridge are apparently in a safe condition at present.

The three bridges to the Terrapin rocks have been repaired. In some instances it was necessary to renew the main stringers of the bridges. The trusses have been repaired, the cross-beams renewed and the three bridges entirely replanked. The present structures should be replaced by new bridges within a year or two.

The water flowing over the Second Sister Island during the storm of January ninth, removed the stone covering from the anchor rods of the second bridge. The stones have been relaid, and the damage caused by the storm repaired.

The cribbing around the base of the rock which supports the south end of the bridge to the Third Sister Island was worn by floating ice, and a portion of the stone filling of the crib washed out. The crib has been refilled and the timber work repaired and protected by a covering of oak plank and sheet iron.

RAILROAD LIVERY PRIVILEGES.

The number of visitors to the Reservation has been as great as in former years, but their stay has been of short duration. This has been largely due to the sale of livery tickets on the railroad trains, by which visitors, without going to the hotels, have been hurriedly taken to "points of interest" outside of the Reservation, places where admission fees are charged, and which are owned or controlled by the firm which had the exclusive privilege of selling livery tickets upon the railroad trains, and in the depot yards, and to bazaars and stores owned or controlled by the same firm. Until recently, the carriage drivers of the livery company have not been allowed to drive visitors to outside "points of interest" or to bazaars or stores not owned or controlled by their employers. The result has been an imposition upon the traveling public, and a great injury to many of the business people of the community, who have been wrongfully discriminated against by the operation of the exclusive livery privileges granted by the railroad companies.

The people coming here to visit the Reservation have been turned over by the railroad companies to a single firm, to be handled in various ways for their financial benefit. The result has been that the object of the State in establishing the Reservation has been to a certain degree defeated.

As instructed by the Commissioners the superintendent stated the facts to the railroad companies in September, 1887, and secured the insertion of certain restrictions in the contract for the exclusive livery privileges. These restrictions, as outlined in the correspondence of the railroad companies with the superintendent, have been from the outset deliberately evaded and ignored by the livery company. During the present season proprietors of hotels, finding the operation of the exclusive livery privilege detrimental to the general business of the place, made complaint to the railroad company, and were assured, that thereafter no soliciting for carriages would be allowed, upon its railroad trains. Notwithstanding this assurance, it is evident, from complaints made at this office that such solicitation still continues. The livery company, also owns or controls bazaars, and "points of interest" where admission fees are charged and to which their passengers are systematically taken, notwithstanding the assurance given to the superintendent, by the railroad company, December 22, 1887, that such a manifestly unjust and improper arrangement would not be permitted.

It is evident that a satisfactory condition of affairs can not exist here so long as the business interests of all of the people in this community who cater to the traveling public are substantially at the mercy of one firm and their employés.

The carriage owners, residents of the village, who have been deprived of employment by the exclusive privileges granted to one firm have been clamorous for employment, and visitors upon the streets, between the depots and the Reservation, have been subjected to frequent solicitation, which local public sentiment, in a measure, palliates, owing to the practical monopoly of the handling of visitors granted to one firm largely foreign to the place. The village authorities can greatly reduce the annoyance of visitors by refusing licenses to drivers, not more than half a dozen in number, who are commonly known to be improper persons, to act as the drivers of carriages used for hire, and by a reasonable enforcement of the village ordinances relating to soliciting and the numbers of carriages and rates of fare.

RESERVATION CARRIAGE SERVICE.

The Reservation carriage service was in operation from June fifteenth to October fifteenth. The existence of the service is

becoming more generally known, and it is constantly growing in favor with the traveling public.

LICENSED CARRIAGE DRIVERS.

Eight public carriage stands have been designated upon the public streets within the Reservation, in the territory outside of the Prospect Park and the islands, at points under the supervision of the Reservation police. The arrangement is a convenience to the traveling public and also a benefit to the carriage drivers.

The privilege of using such stands is subject to revocation in case the driver violates the ordinances of the Commissioners. During the year seven complaints have been made against licensed carriage drivers. Two licensed drivers have been excluded from the Reservation for violation of the ordinances.

HAND RAILING.

The hand railing for the Inclined Railway stairs has been completed. It is 300 feet long, consisting of pine boards, matched and oak hand rail. The railing assists pedestrians in ascending and descending the stairs, and also prevents visitors from falling upon the tracks of the Inclined Railway.

Two hundred feet of iron railing have been erected along the high bank on Goat Island.

Two hundred feet additional of iron guard-rail are required in the vicinity of the new stairway on Goat Island and 600 feet to replace the old and unsightly picket fence along the high bank in Prospect Park.

STAIRWAYS.

The annual examination of the stairways, bridges and railings within the Reservation was completed April twenty-seventh.

A new stairway to the Horseshoe Fall has been built. It consists of nine flights of stairs and nine landings. Three of the landings have balconies for observation and permanent seats for the convenience of visitors. The foundations are of stone laid in cement. The risers are of iron, the stringers of pine and the treads and railing of oak. The stairway affords many fine views of the Horseshoe Falls and the mode of ascent is much more easy than formerly.

At Prospect Point visitors frequently climbed up the terrace on the left in order to continue on their way to the islands. This practice was accompanied by considerable danger. A new flight of stone steps, with copings similar to the two flights already existing, has been constructed in order to afford more convenient access to the Point. The new steps were necessary and they greatly increase the safety and convenience of the public.

The four flights of stone steps in Prospect Park were injured by the ice. They have been repaired, the entrance to Prospect Park at Cascade street repaired, the stone steps at the entrance to Goat Island rebuilt, and the approach to the Third Sister Island bridge repaired.

The structure inclosing the Biddle stairs has been repaired and an additional iron stay-rod fastened from the building to the rock to prevent swaying by the wind. Dangerous stone on the face of the cliff, overhanging the pathway to the Cave of the Winds, has been removed and the pathway cleared and repaired.

The Biddle stairs, although old and unsightly, are apparently strong and safe.

The flight of steps at the entrance to Goat Island was decayed beyond repair. It has been removed and a new stairway with iron risers constructed. New steps have also been built on Goat Island, near the entrance to the Three Sister Islands, and also on the Second Sister Island, to replace a flight of steps carried away by the water during the storm.

An additional substantial stairway is much needed to take the place of the dilapidated steps leading to the Spring on Goat Island.

BUILDINGS.

The Hall, the Library and the summer houses in Prospect Park and on Goat Island have been painted in uniform and more suitable colors. The roof of the gate-keeper's house on Goat Island has been shingled, and the out-houses and stairways upon the Reservation painted.

The Pavilion on Goat Island and the Cave of the Winds building have been repainted. Painting made necessary by the alterations in the Library building has been done and the roof of the Inclined Railway structure repaired and repainted.

The toilet-rooms at the bottom of the Inclined Railway were carried away by the high water during the storm of January last.

New toilet-rooms have been built. A balcony has also been added to the waiting-room at the foot of the Inclined Railway, which doubles the accommodation for visitors and affords a good view of the river and Falls.

A store-room has been built in the lumber yard on Goat Island, and the materials heretofore stored in the Library building in Prospect Park removed thereto.

The stone fountain in Prospect Park has been rebuilt, a new stone walk built at the foot of the Inclined Railway and the stone walk to the dock repaired.

A hard-wood floor should be laid in the Inclined Railway building, the roof resingled and the structure inclosing the Inclined Railway repaired. When this shall have been done, all of the buildings, within the Reservation, will be in good condition.

IRON WATER PIPES.

The iron water conduit, between the lower race, and the reservoir in Prospect Park, has been constructed. It consists of a riveted boiler-iron pipe, twenty-four inches in diameter, extending under Cascade street, walled in with stone and Portland cement at each end. The supply of water, for the operation of the Inclined Railway, received from the pipe is greater than that obtained from the wooden box conduit, formerly in use. Proposals were asked for the construction of the work and the contract awarded to the lowest bidder.

While the iron water-pipe was being placed in position, the wheel-pit in the Inclined Railway building was repaired, and an overflow from the wheel-pit into the tail-race constructed.

The damage done to the pier at the head of the race by the storm of January ninth does not prevent the operation of the Inclined Railway, excepting at times of very low water. The iron conduit affords an abundant supply of water, and by the changes recently made in the wheel-pit, waste of water is prevented, and the water supply more effectually controlled. The reconstruction of the pier would require a considerable outlay, which may be better expended in laying a pipe for a water supply in the present race-way, so that the channel may eventually be filled.

A new manilla cable has been attached to the cars of the Inclined Railway. The average duration of a cable is one year. The cable lately removed was in use and in good condition for nearly two years.

Four pairs of new wheels have been procured for the cars of the Inclined Railway.

CHARTS OF THE LAKE AND RIVER REGION.

Upon the application of Colonel O. M. Poe, Corps of Engineers, Detroit, Mich., a complete set of the Lake Survey Charts has been issued gratuitously for the Library upon the Reservation grounds. The set comprises fifteen charts of Lake Superior, three charts of the River Saint Marie, one chart of the Straits of Mackinac, fifteen charts of Lake Michigan, eight charts of Lake Huron, one chart each of Saint Clair river, Lake St. Clair, and Detroit river; eleven charts of Lake Erie, one chart of Niagara Falls, six charts of Lake Ontario, and six charts of the St. Lawrence river.

The building heretofore known as the Art Gallery has been repaired and remodeled so as to be suitable for a library building. Ten windows have been placed in the alcoves, which were not lighted, the slate roofing and the glass deck have been repaired and all traces of the so-called "Art Gallery" removed. The set of Lake Survey Charts have been framed in proper order and occupy all of the alcoves on the east side and two on the west side of the building. They present to the traveling public an accurate outline of the northern and northwestern lake and river region.

It may be advisable to place in the remaining alcoves photographs of the Falls from the earliest views taken, down to the present time, giving the date of each, and arranging the views in their proper order. Such a collection would show the actual change in the contour of the Falls from year to year and could be added to in the future. The views can now be obtained from the local photographers, and it may be well to make the collection while the older negatives are yet in existence.

On January fourth and fifth large masses of rock fell from the brink of the Horseshoe Falls. The effect of the displacements is visible upon the outline of the Fall.

NURSERY FOR YOUNG TREES.

A piece of ground for the establishment of a nursery for young trees has been prepared upon Goat Island. A small outlay would provide a nursery of young trees indigenous to this locality, from which transplanting could be carried on as soon as the ground should be in condition for planting.

The grounds are now cleared of unnecessary buildings and judicious planting may be done from time to time. The establishment of a nursery for young trees appears to be necessary for the proper prosecution of that work.

GRADING AND PLANTING.

Unnecessary and unsightly buildings having been removed from the river banks, the work of grading and planting may be commenced as soon as the necessary appropriation shall be made.

The bank of the river should be graded and planted as soon as possible. This is particularly true of the strip of land between Cascade street and Mill street, from which buildings have been recently removed. The surface is traversed by race-ways. It is bare and uneven with large hotels and other structures standing out prominently in the background. The river bank in this locality is almost entirely denuded of trees, and it mars the appearance of the Reservation, especially when viewed from the islands, or the Canadian shore. Judicious planting would partially shut out the village from the river bank. Bath Island was almost entirely covered by buildings when the Reservation was established. With the exception of the office building, all have been removed, and considerable grading and filling done, but the Island is almost bare of trees or shrubbery, and presents a bleak and unnatural appearance. It should be properly graded and planted as soon as possible.

Many of the sumachs, which are rapidly overrunning the upper end of Goat Island, should also be removed, and the meadow suitably planted.

In Prospect Park and in some other places where little grading is called for, planting may now be done to replace dead trees and trees recently prostrated by storms.

It having been determined to discontinue the upper raceway between Bridge street and Mill street, the filling of the channel and the grading of the bank of the river in that locality could be carried forward with advantage during the coming season. The removal of the retaining walls, tail-races, and overflows in the vicinity, would greatly improve the appearance of the Reservation.

ROADS AND WALKS.

The approach to Goat Island has been macadamized with broken stone; 500 yards of gravel have been spread upon the carriage turn-outs at the American Fall, the Horseshoe Fall and the Three Sister Islands, and some repairs made upon the roads on the mainland and on the islands.

The roads and foot paths of Goat Island are always in bad condition during the wet season. The road is a common dirt road. It has been repaired with gravel, from time to time, during the year, in order to keep it in passable condition, until such time as the work of constructing permanent roads shall be commenced.

Four hundred loads of material have also been placed upon the roadway between Bridge street and Prospect Park and 600 loads of filling placed upon the Canal street slope adjacent to Bridge street.

The roads and walks within the Reservation have been trimmed and the entire territory upon the mainland mown. The prevailing wet weather rendered much attention necessary to the care of the grass in Prospect Park. The mowing, trimming, clearing away of the fallen trees upon Goat Island, and the ordinary incidental work, has kept the limited number of laborers allowed employed during the year.

The roads within the Reservation are mainly common dirt roads and are entirely inadequate and unsuitable. After rain the road through the woods on Goat Island is very heavy, and being shaded dries slowly. Upon the mainland and included within the Reservation are about two miles of village streets, upon which the village authorities, since the establishment of the Reservation, have ceased to make repairs. These streets, within the Reservation are in some places in bad condition.

A considerable amount has been expended each year in temporary repairs of the roads, which, owing to their defective construction, lack of proper bottoming, drainage and materials, has been largely wasted. Properly constructed roads, such as are eventually contemplated, once established, would cost little for maintenance. Public economy, as well as State pride, urge the early adoption of measures for the permanent improvement of the roads within the Reservation.

Respectfully submitted.

THOMAS V. WELCH,
Superintendent.

REPORT OF THE TREASURER

FOR THE

FISCAL YEAR COMMENCING OCTOBER 1, 1888, AND ENDING
SEPTEMBER 30, 1889.

THE COMMISSIONERS OF THE STATE RESERVATION AT NIAGARA, *in Account*
with HENRY E. GREGORY, *Treasurer.*

1888.

Oct. 1. By balance on hand at this date \$23 46

RECEIPTS.

Oct. 30. Quarterly advance from the State
Comptroller \$5,000 00

1889.

Jan. 9. Quarterly advance from the State
Comptroller 5,000 00

April 6. Quarterly advance from the State
Comptroller 5,000 00

July 9. Quarterly advance from the State
Comptroller 5,000 00

20,000 00

1888.

Nov. 2. Draft on Cataract Bank, October
receipts \$530 45

Dec. 3. Draft on Cataract Bank, Novem-
ber receipts 85 40

31. Draft on Cataract Bank, Decem-
ber receipts 21 75

Feb. 1. Draft on Cataract Bank, January
receipts 49 05

March 2. Draft on Cataract Bank, February
receipts 30 05

31. Draft on Cataract Bank, March
receipts 60 55

May 2. Draft on Cataract Bank, April
receipts... .. 84 20

June 1. Draft on Cataract Bank, May
receipts 355 00

June	30.	Draft on Cataract Bank, June receipts.....	\$435 85	
August	2.	Draft on Cataract Bank, July receipts.....	1,452 85	
Sept.	3.	Draft on Cataract Bank, August receipts.....	2,398 90	
	30.	Draft on Cataract Bank, September receipts	1,743 00	
				\$7,247 05
Dec.	31.	Interest on balances at Manufacturers and Traders' Bank.....	\$18 51	
	1889.			
March	31.	Interest on balances at Manufacturers and Traders' Bank.....	25 59	
June	30.	Interest on balances at Manufacturers and Traders' Bank.....	37 84	
Sept.	30.	Interest on balances at Manufacturers and Traders' Bank.....	29 64	
				111 58
		Total		\$27,382 09

EXPENDITURES.

1888.	No. of abstract.	No. of voucher.		
Nov. 1.	XLVI	480.	Pay-roll at Niagara for October	\$991 79
	XLVI	481.	F. P. Lanigan, insurance ..	3 75
	XLVI	482.	John M. Bowers, Commissioner, traveling expenses	22 90
7.	XLVI	483.	T. V. Welch, Superintendent, office expenses....	3 27
Dec. 3.	XLVI	484.	Pay-roll at Niagara for November	732 00
	XLVI	485.	T. V. Welch, Superintendent, office expenses....	3 25
31.	XLVI	486.	M. Ryan, Inclined Railway machinery.....	23 25
	XLVI	487.	Niagara Falls Printing House, printing	6 00
	XLVI	488.	Wm. Shepard, mason work,	3 00
	XLVI	489.	Macwirth Bros., slate work	9 15
	XLVI	490.	The Bell Telephone Co...	10 30
	XLVI	491.	T. B. Secord, lumber	54 18

1888.	No. of abstract.	No. of voucher.		
Dec. 31.	XLVI	492.	H. C. Harrower, needle beams.....	\$448 00
	XLVI	493.	P. C. Flynn & Son, painters,	39 64
	XLVI	494.	David Phillips, bridges ...	198 96
	XLVI	495.	J. Binkley, coal	38 45
	XLVI	496.	J. Johnson, smith work....	16 32
	XLVI	497.	Phillips & Young, iron pipe	485 00
	XLVI	498.	H. S. Ware, hardware	90 69
	XLVI	499.	Rhodes & Babcock, sta- tionery.....	4 10
	XLVI	500.	Niagara Falls Gas-light Co.	1 82
	XLVI	501.	Cataract Bank, for A. P. Burdick.....	6 22
	XLVI	502.	George E. Wright & Co., stairway	16 97
	XLVI	503.	Niagara Falls Water-works Co.....	140 00
	XLVI	504.	Jas. Mooney, Commissioner, traveling expenses	1 75
	XLVI	505.	Henry E. Gregory, Treas- urer and Secretary, sal- ary for October, Novem- ber and December	275 00
	XLVI	506.	Henry E. Gregory, Treas- urer and Secretary, trav- eling expenses	58 09
	XLVI	507.	Henry E. Gregory, Treas- urer and Secretary, office expenses	12 18
	XLVI	508.	John Hodge, Commis- sioner, traveling expenses	5 52
	XLVI	509.	Pay-roll at Niagara for December	744 92
				\$4,446 47
1889.				
Jan. 10.	XLVII	510.	T. V. Welch, Superinten- dent, office expenses....	\$1 14
Feb. 1.	XLVII	511.	Pay-roll at Niagara for January.....	766 79
	XLVII	512.	T. V. Welch, Superinten- dent, office expenses....	4 05

1889.	No. of abstract.	No. of voucher.			
Feb. 1.	XLVII	513.	Henry E. Gregory, Treas- urer and Secretary, sal- ary for January.....	\$91 70	
Mar. 1.	XLVII	514.	Pay-roll at Niagara for February	716 86	
	XLVII	515.	T. V. Welch, Superinten- dent, office expenses....	4 50	
14.	XLVII	516.	Philpott & Leuppie	21 77	
	XLVII	517.	Niagara Falls Gas-light Co.	2 86	
	XLVII	518.	P. B. Secord, buildings ...	122 25	
	XLVII	519.	J. Binkley, coal	58 46	
	XLVII	520.	Maloney & McCoy, ice....	50 09	
	XLVII	521.	H. S. Ware, hardware.....	38 42	
	XLVII	522.	P. C. Flynn & Son... ..	44 86	
	XLVII	523.	Niagara Falls Printing House	3 00	
	XLVII	524.	The Bell Telephone Co....	6 00	
	XLVII	525.	Henry E. Gregory, Treas- urer and Secretary, trav- eling and office expenses	30 70	
30.	XLVII	526.	Pay-roll at Niagara for March	794 95	
					\$2,758 40
Apr. 3.	XLVIII	527.	Daniel Batchelor, Commis- sioner, traveling expenses	\$9 50	
4.	XLVIII	528.	T. V. Welch, Superinten- dent, office expenses....	31 50	
6.	XLVIII	529.	John Hodge, Commis- sioner, traveling expenses	21 40	
May 2.	XLVIII	530.	Pay-roll at Niagara for April	846 10	
	XLVIII	531.	T. V. Welch, Superinten- dent, office expenses....	46 33	
June 3.	XLVIII	532.	Pay-roll at Niagara for May	1,095 12	
	XLVIII	533.	T. V. Welch, Superinten- dent, office expenses....	48 91	
	XLVIII	534.	Henry E. Gregory, Treas- urer and Secretary, sal- ary for February, March, April and May.....	366 66	

1889.	No. of abstract.	No. of voucher.		
June 29.	XLVIII	535.	J. Binkley, coal	\$17 49
	XLVIII	536.	Wm. Wall's Sons.....	179 60
	XLVIII	537.	Kearney & Barrett	90 00
	XLVIII	538.	Philpott & Leuppie, tools, etc	10 39
	XLVIII	539.	Jackson Architectural Iron Works	200 00
	XLVIII	540.	H. S. Ware	82 73
	XLVIII	541.	P. C. Flynn & Son.....	317 24
	XLVIII	542.	P. C. Flynn & Son.....	115 56
	XLVIII	543.	M. A. McBean, seed.....	5 94
	XLVIII	544.	J. Johnson, tools	4 86
	XLVIII	545.	James Reynolds, iron rail- ing.....	60 00
	XLVIII	546.	D. Phillips.....	577 52
	XLVIII	547.	D. Phillips.....	203 67
	XLVIII	548.	G. W. Wright.....	49 49
	XLVIII	549.	William Shepard.....	156 76
	XLVIII	550.	William Young, cartage...	10 10
	XLVIII	551.	Drake Whitney, surveying,	5 00
	XLVIII	552.	Downing Vaux, map.....	50 00
	XLVIII	553.	De Grauw, Aymar & Co., National flag.....	12 75
	XLVIII	554.	Henry E. Gregory, Treas- urer and Secretary, trav- eling expenses.....	34 40
	XLVIII	555.	Henry E. Gregory, Treas- urer and Secretary, office expenses	36 39
	XLVIII	556.	Henry E. Gregory, Treas- urer and Secretary, salary for June.....	91 66
	XLVIII	557.	Pay-roll at Niagara for June	995 91
	XLVIII	558.	James McCarthy	21 00
	XLVIII	559.	T. V. Welch, Superintend- ent, office.....	4 55
	XLVIII	560.	D. Phillips.....	97 90
	XLVIII	561.	George E. Wright & Co...	88 69
				\$5,985 12

1889.	No. of abstract.	No. of voucher.		
Aug. 1.	XLIX	562.	Pay-roll at Niagara for July	\$1,198 50
	XLIX	563.	F. P. Lanigan, insurance ..	20 00
	XLIX	564.	Daniel Batchelor, Commis- sioner, traveling expenses	24 47
	XLIX	565.	John M. Bowers, Commis- sioner, traveling expenses	31 00
	XLIX	566.	Henry E. Gregory, Treas- urer and Secretary, salary for July	91 66
3.	XLIX	567.	John Hodge, Commissioner, traveling expenses	1 84
	XLIX	568.	T. V. Welch, Superintend- ent, office	32 88
Sept. 3.	XLIX	569.	Pay-roll at Niagara for August	1,197 50
	XLIX	570.	T. V. Welch, Superintend- ent, office	20 62
4.	XLIX	571.	Henry E. Gregory, Treas- urer and Secretary, sal- ary for August	91 66
30.	XLIX	572.	James McCarthy, ...	108 50
	XLIX	573.	Wm. Shepard	238 35
	XLIX	574.	G. Elias & Bro.	241 97
	XLIX	575.	James McCarthy	108 50
	XLIX	576.	Geo. W. Tifft Sons & Co ..	25 40
	XLIX	577.	D. Phillips	19 45
	XLIX	578.	D. Phillips	91 85
	XLIX	579.	D. Phillips	174 59
	XLIX	580.	Phillips & Co.	168 98
	XLIX	581.	Geo. E. Wright & Co.	190 31
	XLIX	582.	Geo. E. Wright & Co.	59 73
	XLIX	583.	H. S. Ware	257 15
	XLIX	584.	P. C. Flynn & Son	229 85
	XLIX	585.	P. C. Flynn & Son	58 41
	XLIX	586.	J. Johnson	13 95
	XLIX	587.	Thomas Cleary	23 63
	XLIX	588.	Wm. Pool & Son, advertis- ing	2 25
	XLIX	589.	Philpott & Leuppie	45 98

	No. of abstract.	No. of voucher.		
1889.	XLIX	590.	E. O. Babcock, stationery..	\$11 60
	XLIX	591.	Geo. S. Hanes, tools	4 50
	XLIX	592.	Peter A. Porter, advertising	2 75
Sept. 30.	XLIX	593.	S. S. Pomroy	2 70
	XLIX	594.	James McCarthy	92 75
	XLIX	595.	The Bell Telephone Co...	3 10
	XLIX	596.	T. V. Welch, Superinten- dent, office expenses....	4 78
	XLIX	597.	Henry E. Gregory, Treas- urer and Secretary, sal- ary for September.....	91 66
	XLIX	598.	Henry E. Gregory, Treas- urer and Secretary, trav- eling expenses	77 80
	XLIX	599.	Henry E. Gregory, Treas- urer and Secretary, office expenses	15 03
	XLIX	600.	Niagara Water-works Co..	140 00
	XLIX	601.	Pay-roll at Niagara for September	1,127 00
				\$6,342 65

Remittances to State Treasurer.

1888.				
Nov.	2.	Draft for October receipts.....	\$530 45	
Dec.	3.	Draft for November receipts.....	85 40	
	31.	Draft for December receipts.....	21 75	
1889.				
Feb.	1.	Draft for January receipts.....	49 05	
Mar.	2.	Draft for February receipts	30 05	
	31.	Draft for March receipts.....	60 55	
May	2.	Draft for April receipts	84 20	
June	1.	Draft for May receipts.....	355 00	
	30.	Draft for June receipts.....	435 85	
Aug.	2.	Draft for July receipts.....	1,452 85	
Sept.	3.	Draft for August receipts.....	2,398 90	
	30.	Draft for September receipts.....	1,743 00	
				7,247 05

1888.

Dec. 31. Draft for balance of interest on hand,	\$35 14
Draft for interest.	\$18 51

1889.

Mar. 31. Draft for interest.	25 59	
June 30. Draft for interest.	37 84	
Sept. 30. Draft for interest.	29 64	
		111 58
		\$146 72
		\$26,926 41
Sept. 30. Balance in Treasurer's hands.		455 68
Total.		\$27,382 09

HENRY E. GREGORY,
Treasurer.

Examined and found correct November 19, 1889.

JOHN M. BOWERS,
Auditing Committee.

RECEIPTS FOR THE YEAR ENDING SEPTEMBER 30, 1889.

1888.

Inclined Railway.

October.	\$229 30
November	84 10
December	20 25
1889.	
January	49 05
February	13 05
March	58 55
April	84 20
May	242 00
June	423 85
July	1,042 85
August	1,888 90
September	938 00
Total	\$5,074 10

<i>Leases.</i>	
1888.	
October	\$300 00
1889.	
May	100 00
June	10 00
July	410 00
August	510 00
September	805 00
Total	<u>\$2,135 00</u>

<i>Sales.</i>	
1888.	
October	\$1 15
November	1 30
December	1 50
1889.	
February	17 00
March	2 00
May	13 00
June	2 00
Total	<u>\$37 95</u>

RECAPITULATION.	
Inclined Railway	\$5,074 10
Leases	2,135 00
Sales	37 95
Total	<u>\$7,247 05</u>

SIXTH ANNUAL REPORT OF THE

DETAILED STATEMENT OF LEASES AND SALES.

Leases.

Date.	Number of lease.	NAME.	What leased.	Amount.
1888.				
Oct ..	2	G. W. Wright	Cave of the Winds.	\$300 00
1889.				
May ..	1	Maid of the Mist Ass'n...	Steamboat	100 00
June ..	3	J. F. Reilley.....	Baggage room....	10 00
July ..	1	Maid of the Mist Ass'n...	Steamboat.....	100 00
	2	G. W. Wright	Cave of the Winds.	300 00
	3	J. F. Reilley.....	Baggage room....	10 00
Aug ..	1	Maid of the Mist Ass'n...	Steamboat.....	100 00
	2	G. W. Wright	Cave of the Winds.	300 00
	3	J. F. Reilley.....	Baggage room....	10 00
		J. C. Level, Agent Res'n...	Carriage service...	100 00
Sept..	1	Maid of the Mist Ass'n...	Steamboat.....	200 00
	2	G. W. Wright	Cave of the Winds.	600 00
	3	J. F. Reilley.....	Baggage room....	5 00
		Total .....	.....	\$2,135 00

Sales.

Date.	NAME.	What sold.	Price.	Amount.
1888.				
October ..	John Chambers ..	One 6-light sash ..	\$0 50	
	T. Tugby.....	Two 4-light sash..	65	\$1 15
November.	T. Tugby.....	Two sash		1 30
December.	T. Tugby.....	Three old sash ...		1 50
1889.				
February..	.....	Fallen wood from Goat Island		17 00
March ....	.....	Fallen wood from Goat Island		2 00
May .....	.....	Fallen wood from Goat Island	\$10 00	
	H. E. Slocum	Three old signs...	3 00	13 00
June .....	.....	Fallen wood from Goat Island		2 00
	Total .....	.....		\$37 95

1888.	PAY-ROLLS.	
October.....		\$991 79
November.....		732 00
December.....		744 92
1889.		
January.....		766 79
February.....		716 86
March.....		794 95
April.....		846 10
May.....		1,095 12
June.....		995 91
July.....		1,198 50
August.....		1,197 50
September.....		1,127 00
Total.....		<u><u>\$11,207 44</u></u>

CLASSIFICATION OF PAY-ROLLS.		
Salaries.....		\$2,614 94
Police.....		4,083 08
Inclined Railway.....		1,394 00
Prospect Park.....		930 76
Roads.....		1,364 16
Goat Island.....		611 25
Buildings.....		138 75
Railing.....		70 50
Total.....		<u><u>\$11,207 44</u></u>

NUMBER OF EMPLOYEES DURING THE YEAR ENDING SEPTEMBER 30, 1889.

YEAR.	Permanent employés.	Laborers.	Teamsters.	Total.
1888.				
October.....	10	7	1	18
November.....	10	7	1	18
December.....	10	5	.....	15
1889.				
January.....	10	4	.....	14
February.....	10	3	.....	13
March.....	10	3	3	16
April.....	10	5	2	17
May.....	10	10	1	21
June.....	10	11	.....	21
July.....	10	9	.....	19
August.....	10	9	.....	19
September.....	10	9	.....	19

EXCURSIONS FOR THE YEAR ENDING SEPTEMBER 30, 1889.

Date.	WHERE FROM.	Number of cars.	Estimated number of visitors.
1888.			
Oct. 10	Boston, Raymond excursion	2	120
10	Erie railway	5	300
		7	420
1889.			
May 1, 2	Five regiments return. from N. Y. Cen.	40	2,500
3	Lockport, union school.	4	240
5	Buffalo, via N. Y. C. railroad.	4	240
		48	2,980
June 10	Port Rowan, via Grand Trunk railway.	5	300
11	Toronto, Ont., Baptist Church Society.	4	240
11	St. Thomas', Ont., "Grangers"	9	540
15	Rochester, N. Y., Railroad Employés, via West Shore railroad	4	240
15	Brewers' Convention	4	240
15	Buffalo, N. Y., Church of the Ascension Society, via N. Y. C. railroad.	6	360
15	Hamilton, Ont., Baptist Church Soc. . .	3	180
16	New York, N. Y., Brooklyn Sangerbund	4	240
16	Buffalo, N. Y., Turner Society.	2	120
16	Buffalo, N. Y., via N. Y. C. railway. . . .	7	420
16	Buffalo, N. Y., via Erie railway.	3	180
16	Buffalo, N. Y., via N. Y. C. railway. . . .	5	300
18	Amer. Railway Master Mechanics' Ass'n	6	360
18	Emporium, via B., N. Y. and Pa. rail'y.	4	240
23	Buffalo, N. Y., via N. Y. C. railway. . . .	15	900
23	Jamestown, N. Y., via N. Y. C. railway.	3	180
24	Toronto, Ont., Ch of the Ascen. Soc'y	3	180
25	Toronto, Ont., Cook's Church of the Ascension Society	3	180
25	Sons of Veterans, via West Shore Ry. .	4	240
27	New Jersey Editorial Association. . . .	5	300
27	Carter's Vestibule Train, Chicago Exp.	6	360
27	Toronto, Ont., Zion church	4	240
30	Serant'n and C'bondale, Pa., via Erie Ry.	12	720
30	Jamestown, N. Y., via N. Y. C. railway.	4	240
30	Buffalo, N. Y., via N. Y. C. railway. . . .	11	660
30	Elmira, N. Y., via Erie railway	12	720
30	Susqu'na and Binghamton, via Erie Ry.	6	360
30	Buffalo, N. Y., via Erie railway.	2	120
30	Lockport, N. Y., via Erie railway.	1	60
		157	9,420

EXCURSIONS — (*Continued*).

Date.	WHERE FROM.	Number of cars.	Estimated number of visitors.
1889.			
July 1	Toronto, Ont., Manchester Unity Ldg., I. O. of O. F.	4	240
1	Toronto, Ont., Dominion Day Excur. .	6	360
1	Kingston, Ont., Kingston Rifles	2	120
1	Hamilton, Ont., Dominion Day Excur. .	5	300
1	Buffalo, N. Y., via Erie railway	6	360
1	Toronto, Ont., via Erie railway	1	60
1	Toronto, Ont., via Street cars for Suspension Bridge . . . . .	.....	100
2	Buffalo, N. Y., Lafayette St. Ch. Soc'y. .	5	300
2	Rochester, N. Y., via P. and E. railroad	6	360
4	Via N. Y. C. and West Shore railway . .	35	2,100
4	Albany, N. Y., via N. Y. C. Ry. (special)	8	480
4	Hornellsville, N. Y., via Erie railway . .	10	600
4	Toronto, Ont., Rheaboan Lodge	4	240
4	Buffalo, N. Y., via Erie railway	14	840
4	Lockport, N. Y., via Erie railway	4	240
5	Toronto, Ont., Gallic Society	4	240
6	Toronto, Ont., Western Lodge, I. O. of O. F.	4	240
6	Buffalo, N. Y., Western Amateur Press Association	1	60
7	Buffalo, N. Y., Sunday train	13	780
7	Lockport, N. Y., Sunday train	4	240
7	Toronto, Ont., Bleiven Street Baptist Church Society	2	120
7	St. Catherine's, Ont., Baptist Church Separate School	2	120
9	Buffalo, N. Y., St. James' Epis. church. .	4	240
9	Toronto, Ont., Brown Street church . .	4	240
9	Queen Victoria Park . . . . .	.....	100
10	Buffalo, N. Y., Baptist church	7	420
10	Buffalo, N. Y., I. O. of O. F., Rebekah Lodge	6	360
10	Buffalo, N. Y., Railway Accountants . .	4	240
13	Hamilton, Ont., Grand Trunk Railway Employés	15	900
14	Cleveland, O., via Nickel Plate railway. .	7	420
14	Bradford, Pa., via Erie railway	5	300
15	Toronto, Ont., Toronto Opera House Ushers	2	120
14	Buffalo, N. Y., via N. Y. C. railway . .	13	780
15	Toronto, Ont., St. Vincent de Paul Soc. .	12	720
16	Toronto, Ont., All Saints Church Soc. .	6	360
16	Hamilton, Ont., via Hamilton and Northwestern railway	4	240

EXCURSIONS — (*Continued*).

Date.	WHERE FROM.	Number of cars.	Estimated number of visitors.
18 9.			
July 17	Toronto, Ont., Choir of the Church of the Redeemer	4	240
18	Franklin, Oil City and Meadville, Pa., via N. Y., P. and O. railway	9	540
19	Cleveland, O., via Erie railway.	6	360
19	Toronto, Ont., employés, Grand Trunk railway	8	480
20	Toronto, Ont., employés, Heinzeman's piano factory	9	540
20	Toronto, Ont., Grand Trunk railway conductors	7	420
21	Buffalo, N. Y., via Erie railway	2	120
21	Via Lake Shore and Michigan Southern railway	9	540
21	Le Roy, Batavia and Rochester via Erie railway	12	720
21	Via Western New York and Pennsylvania railway	7	420
21	Rochester, N. Y., via Erie railway	4	240
21	Lockport, N. Y., via Erie railway	2	120
21	Buffalo, N. Y., via New York Central railway	23	1,380
22	Toronto, Ont., Christie, Brown & Co., employés	6	360
23	Chautauqua (Newton's) via Buffalo, New York and Philadelphia railway, ...	5	300
23	Toronto, Ont.	2	120
24	Lexington, Ky.	1	60
24	Syracuse, Weedsport, etc., via New York Central railway	4	240
25	Toronto, Ont., Ladies Aid Society	4	240
25	Bradford, Ont., Methodist Episcopal Church Society	5	300
25	Erie, Pa., Methodist Episcopal Church Society	10	600
25	Chicago, Ill., Vestibule express train	5	300
26	Toronto, Ont., nut and bolt manufacturing company	6	360
26	Chautauqua, N. Y., Newton's via Buffalo, New York and Philadelphia Ry., ...	8	480
27	Toronto, Ont., Switchmen's Mutual Aid Association	7	420
27	Guelf, Ontario, Bell Organ Manufacturing company	6	360
28	Philadelphia, Pa., Old Settler's express, ...	10	600

EXCURSIONS — (*Continued*).

Date.	WHERE FROM.	Number of cars.	Estimated number of visitors.
1889.			
July 28	Lockport, N. Y., via Erie railway	6	360
28	Lockport, N. Y., via New York Central railway	4	240
28	Buffalo, N. Y., via New York Central railway	19	1,140
28	Rochester, N. Y., via West Shore railway	9	540
29	Toronto, Ont., Taylor Manufacturing Company	5	300
29	Owen Sound, Ont., Young Men's Christian Association	4	240
29	Toronto, Ont., St. Bartholomew's church	5	300
30	Toronto, Ont., St. Matthew's church . .	4	240
30	Oil City, Olean, etc.	4	240
31	Oshawa, Ont., via Grand Trunk railway,	4	240
		474	28,640
Aug. 1	Medina, Middleport and Lockport via New York Central railway	14	840
1	Toronto, Ont., Dr. Wild's church	4	240
1	Chicago, Ill., Vestibule train	5	300
2	Toronto, Ont., Methodist Episcopal church	4	240
2	Ransomville, Wesley Methodist Episcopal church	2	120
2	Cincinnati, Dayton, Lima, etc., via Cincinnati, Hamilton and Dayton railway	95	5,700
3	Chautauqua, N. Y.	4	240
3	Erie, Pa., Watson Paper Manufacturing Company, employes	10	600
3	Toronto, Ont., Trade and Labor Union,	5	300
3	Rochester, N. Y., via West Shore railway	5	300
3	Red Creek, Sodus, etc., via R., W. and O. railway	10	600
4	Pittsburg, Pa.	16	960
4	Cleveland, O., via Nickel Plate railway,	41	2,460
4	Lockport, N. Y., via Erie railway	5	300
4	Buffalo, N. Y., via New York Central railway	19	1,140
4	Buffalo, N. Y., via West Shore railway,	10	600
4	Rochester, N. Y., via West Shore railway	8	480
5	Toronto, Ont., Zion Cong. church	5	300
6	Buffalo, N. Y., Hudson Street Baptist church	8	480
6	Buffalo, N. Y., Lovejoy Street Presbyterian church	8	480

EXCURSIONS — (*Continued*).

Date.	WHERE FROM.	Number of cars.	Estimated number of visitors.
1889.			
Aug. 6	Lockport, N. Y., Methodist Episcopal church	7	420
6	Toronto, Ont., Trinity church.	4	240
6	Electric Light convention.	7	420
6	Buffalo, N. Y., via Erie railway.	6	360
7	Canandaigua, N. Y., via New York Central railway	10	600
7	Milton, Ont., via North Western railway.	7	420
7	Oil City and Meadville, Pa.	10	600
7	Springfield, Peoria and Bloomington, Ill., via N. Y., P. and O. railway . . .	48	2,880
8	Gowanda, N. Y., Meth. Epis. church . .	5	300
8	Dansville and Bath, N. Y., via Delaware, Lackawanna and Western railway. . .	12	720
8	London, Ont., general railway excursion	7	420
8	Indianapolis, Ind., via C. C. C. and I. railway	8	480
8	Kansas City, Mo.	6	360
9	Oakville, Ont.	4	240
9	Waterloo, N. Y., Harugari Society . . .	3	180
9	Philadelphia, Pa.	4	240
10	Toronto, Ont., stone masons and bricklayers.	4	240
10	Chautauqua, N. Y., Newton's excursion.	5	300
11	Buffalo, N. Y., via New York Central railway	21	1,260
11	Lockport, N. Y., via Erie railway	5	300
11	Buffalo, N. Y., via West Shore railway.	4	240
11	Rochester, N. Y., via Erie railway. . . .	8	480
12	Toronto, Ont., via Erie railway	7	420
12	Toronto, Ont., civic holiday.	15	900
12	St. Catherines, civic holiday.	4	240
13	Chicago, Valparaiso and Cleveland via Nickel Plate railway.	34	2,040
13	Lockport, N. Y., Baptist and Southern churches.	10	600
13	Buffalo, N. Y., Catholic Ind. school . . .	4	240
14	Lockport, N. Y., German Luth. church.	7	420
14	Buffalo, N. Y., Order of United Friends of America.	16	960
14	Dansville and Bath, N. Y., via Delaware, Lackawanna and Western railway . .	6	360
14	St. Catherines, Ont., I. O. of O. F. . . .	4	240
15	Youngstown, O.	10	600
15	Lisbon, O., Quaker excursion.	9	540

EXCURSIONS — (*Continued*).

Date.	WHERE FROM.	Number of cars.	Estimated number of visitors.
1889.			
Aug. 15	Via R. W. & O. railway	10	600
15	Toronto, Ont., Foresters	9	540
15	Peterboro, Ont., via Grand Trunk Ry .	8	480
15	Cincinnati, O., via Erie railway	15	900
16	Baltimore, Washington and Philadelphia via N. C. and N. Y. C. railway . .	30	1,800
18	Newark, Port Jervis and Paterson, N. J., via Erie railway	21	1,260
18	Pittsburg, Pa., via Lehigh Valley	9	540
18	Pittsburg, Pa., via Northern Central and New York Central railway	10	600
18	Youngstown, O.	9	540
18	Rochester, N. Y., via R. W. and O. Ry.	12	720
18	Cleveland, O., via L. S. and M. S. Ry. .	8	480
18	Lockport, N. Y., via Erie railway	4	240
18	Buffalo, N. Y., via New York Central railway	41	2,460
19	Toronto, Ont., Kilgore Brothers Manufacturing Company	4	240
19	Streetsville, Ont., A. O. U. W. via Canada Pacific railway	8	480
19	Brooklyn, N. Y., Thirteenth Regiment, N. G. N. Y. S.	9	540
20	Erie railway	18	1,080
20	Buffalo, Pittsburg and Rochester	12	720
20	Attercliff, Ont., via Grand Trunk Ry . .	8	480
20	Philadelphia, Pa., via Lehigh Valley Ry.	6	360
20	St. Catherines, Ont., Mich. Cent. Ry. . .	8	480
20	Seda, Mich., via Erie railway	12	720
20	Fort Wayne, Ind.	13	780
21	Brampton, Ont., Peel county, Pioneer picnic	8	480
21	Toronto, Ont., St. Matthew's English church	4	240
21	Elmira, N. Y.	9	540
21	Ohio and Indiana via Nickel Plate Ry.	21	1,260
21	Hornellsville, Rochester and Batavia, N. Y., via Erie railway	25	1,500
21	Toronto, Ont.	5	300
22	Newark and Akron via West Shore Ry.	20	1,200
22	Bradford, Pa.	18	1,080
22	Erie railway	12	720
23	Philadelphia, Pa.	8	480
23	Am. Florists' Asso. (Conv. at Buffalo),	7	420
23	New York, Pennsylvania and Ohio Ry..	32	1,920

EXCURSIONS — (Continued).

Date.	WHERE FROM.	Number of cars.	Estimated number of visitors.
1889.			
Aug. 23	Albany, N. Y., via West Shore railway.	14	1,080
23	Toronto, Ont., St. Phillip's church . . .	6	360
23	Cincinnati, O., via Cincinnati, Hamilton and Dayton railway	30	1,800
23	Chautauqua, N. Y.	6	360
23	Somersville, Ky.	4	240
24	Toronto, Ont., employés Abell Iron Works	6	360
24	Salamanca, N. Y., via Erie railway . . .	10	600
24	Auburn, N. Y., "Knights of Pythias."	10	600
24	New Hampshire and Rhode Island, "G. A. R.," en route	12	720
24	Cleveland, O., via Nickel Plate railway.	9	540
25	Lockport, N. Y., via Erie railway	5	300
25	Buffalo, N. Y., via Erie railway	5	300
25	Rochester, N. Y., via West Shore Ry. .	12	720
25	Buffalo, N. Y., via N. Y. C. railway . . .	20	1,200
23	St. Louis, Mo., and Springfield, Ill., via Erie railway	15	900
23	Cincinnati, O., and Philadelphia, Pa. . .	20	1,200
23	Allenburg, Ont., in wagons . . . . .	.....	100
24	Rochester, N. Y.	5	300
24	Buffalo, N. Y.	4	240
24	Lockport, N. Y.	2	120
26	Galt, Ont., Forester and Temperance societ	6	360
27	Toronto, Ont., St. Stephen's church . . .	8	480
27	Hagersville, civic holiday excursion . .	13	780
29	Lockport, N. Y., German Lutheran Ch.	9	540
29	Toronto, Ont., M. E. church	5	300
29	Harrison Valley, Pa.	9	540
30	Baltimore, Washington and Philadelphia (Trox)	15	900
30	Syracuse, Utica and Rochester, via West Shore railway	9	540
29	Toronto, Ont.	7	420
31	Grand Trunk Employés.	23	1,380
31	American Scientific Association Conv. .	6	360
		<u>1,357</u>	<u>81,760</u>
Sept. 1	Morris Run, Pa.	9	540
1	Corning & Elmira, N. Y., via Erie rail'y	12	720
1	Rochester, N. Y., via West Shore rail'y	8	480
1	Lockport, N. Y., via Erie railway	5	300
1	Buffalo, N. Y., via N. Y. C. railway . . .	19	1,140

EXCURSIONS — (Continued).

Date.	WHERE FROM.	Number of cars.	Estimated number of visitors.
1889.			
Sept. 1	Buffalo, N. Y., via Erie railway	3	180
2	Queen Victoria Park . . . . .	.....	200
2	Rochester, N. Y., Dutch Reformed and M. E. churches	8	480
2	Berlin, Ont., Concordia Society	6	360
4	Erie, Pa., union excursion of Clark's Business Coll. and Lutheran church.	10	600
4	Caledonia, Ont., Presbyterian church	5	300
4	Meadville, Pa., via Erie railway	9	540
4	Cincinnati, O., via Erie railway	6	360
5	Hamilton, Ont., "Kni'ts of Maccabees."	10	600
5	Woodbridge, Ont., English church	5	300
6	Scranton, Pa., via O., L. and W. rail'y.	12	720
7	Buffalo, N. Y., visitors to Buffalo fair.	20	1,200
7	Boston, Mass., Raymond excursion	4	240
7	Bell's Gap, Pa.	8	480
8	Lockport, N. Y., via Erie railway	5	300
8	Buffalo, N. Y., via N. Y. C. railway	47	2,820
8	Rochester, N. Y., via West Shore rail'y	6	360
8	Rochester, N. Y., via Erie railway	7	420
8	Buffalo, N. Y., via Erie railway	3	180
8	Lockport, N. Y., via Erie railway	2	120
11	Hartford, Conn., "Putnam Phalanx"	3	180
13	Buffalo, N. Y., via Erie railway	16	960
14	New York city, via N. Y. C. railway	6	360
15	Elizabeth and Newark, N. J., via Erie railway	12	720
15	Buffalo, N. Y., via Erie railway	4	240
15	Lockport, N. Y., via Erie railway	2	120
15	Buffalo, N. Y., via N. Y. C. railway	14	840
17	Toronto, Ont., visitors from	8	480
21	Philadelphia, Pa., via Erie railway	2	120
24	Medina, N. Y., via N. Y. C., Frary Engine Company	2	120
24	Dunkirk, N. Y., via N. Y. C., Pioneer Engine Company	2	120
24	Hornellsville and Attica, via Erie rail'y	8	480
26	Bath, N. Y., via Erie railway	8	480
27	Canandaigua, Leroy and Batavia, via Erie railway	8	480
		324	19,640

54 SIXTH ANNUAL REPORT ON STATE RESERVATION AT NIAGARA.

EXCURSIONS — RECAPITULATION — (*Concluded*).

Year.	MONTH.	Cars.	Persons.
1888.....	October	7	420
1889.....	May	48	2,980
1889.....	June	157	9,420
1889.....	July	474	28,640
1889.....	August	1,357	81,760
1889.....	September	324	19,640
		2,367	142,860

APPENDIX.

LETTERS.

NEW YORK, *April 3, 1889.*

To the Honorable the Legislature:

The attention of the Commissioners of the State Reservation at Niagara has been directed to a bill introduced into the Legislature on the fourteenth ult., and entitled "An act to authorize the Niagara Hydraulic Electric Company to erect machinery under Niagara Falls for the purpose of utilizing the water-power of said Falls for manufacturing electricity and to erect the necessary machinery for the same."

The Commissioners respectfully represent that, in their judgment, this bill should not become a law.

By chapter 286, Laws of 1885, the lands of the Niagara Reservation were placed under the control and management of commissioners whose duty it is to restore the natural scenery of the Falls, and to see to it that the object of the State in acquiring these lands is not defeated.

To pass this bill would be to act in direct opposition to this object as expressed by the Law of 1885.

The Honorable the Legislature is aware that it was mainly for the purpose of preventing private persons and corporations from appropriating and disfiguring the waters and banks of the Niagara river in commercial and money-making enterprises, that the lands of the Reservation were made public property for the use and enjoyment of the people.

Since the Commissioners were appointed, mills and factories that had been erected, from time to time, on the islands and shore of the Niagara, with their machinery, have been removed. The lands of the Reservation having been freed from these encumbrances, the scenery of the Falls may now be said to be in the way of restoration to its original sylvan condition, and the expressed object of the law, in process of execution.

The Commissioners, to whom the State has committed the care of the public domain at Niagara, deem it a duty to call the attention of the Honorable the Legislature to the manifest inconsistency of this and all similar schemes to make use of the lands of the Reservation, or the water-power of the Falls, for manufacturing purposes, and bespeak the coöperation of the Legislature in their efforts to preserve the scenery of the great cataract from fresh and most objectionable intrusions.

The Commissioners respectfully represent that this proposed encroachment upon the Reservation and the consequent injury to the scenery that would follow the passage of the bill above referred to, would be in direct contravention of the objects for which the Reservation was established, as repeatedly expressed in the laws of the State, and that the bill, therefore, should not be received with favor by your honorable body.

Very respectfully.

ANDW. H. GREEN,

President Commissioners of the State Reservation at Niagara.

NEW YORK, *April 4, 1889.*

HON. SAMUEL FREDERICK NIXON,

Chairman Assembly Committee on Internal Affairs :

DEAR SIR.—I have been informed that a bill, entitled “An act to authorize the Niagara Hydraulic Electric Company to erect machinery under Niagara Falls,” etc., introduced into the Legislature March fourteenth, has been referred to the Committee on Internal Affairs in the Assembly.

I have addressed a communication to the Legislature stating objections to this measure.

The bill, as you are no doubt aware, gives the said company permission to extend pipes and receivers and such machinery as may be required under the Falls, and to cross the lands of the Reservation with their machinery and appliances, and also to erect one or more elevators.

This bill is in direct contravention of the objects for which the State made the Reservation public property. The Commissioners

of the State Reservation have been engaged for several years in getting rid of mills and machinery, a part of which was an electric plant. It is now proposed by this bill to recommence the work of defacing the scenery of the Falls by the erection of other structures similar to those that have been removed and equally objectionable.

Permit me to direct your attention to the communication, recently sent to the Legislature, on this subject. It is hardly necessary for me to repeat that the Commissioners regard the bill and its objects as well as all similar schemes for money-making at the Falls, with the utmost disfavor, and they trust that you will so effectually discountenance this scheme as to discourage the projectors of others of the same sort that are intended to subserve no justifiable public purpose.

Very respectfully yours.

ANDW. H. GREEN,

President Commissioners of the State Reservation at Niagara.

NEW YORK, *April 5, 1889.*

HON. GEORGE B. SLOAN, *Senate :*

DEAR SIR.—I addressed a communication to the Legislature on the third instant, stating objections to the bill entitled "An act to authorize the Niagara Hydraulic Electric Company to erect machinery under Niagara Falls," etc. This bill was introduced into the Senate by Senator Raines on March fourteenth.

The purpose of the bill is so antagonistic to the plan and object of the State in establishing the Reservation, that it would seem only necessary to direct the attention of the Legislature to its provisions to ensure its defeat.

The Commissioners of the State Reservation at Niagara propose to carry out the intention of the Legislature in acquiring this property for the public use, and they desire to prevent any encroachment upon the Reservation that would defeat this intention.

It is not long since that the Commissioners disposed of an electric plant which came into their possession when the lands of the Reservation became public property.

The Commissioners trust that you will use your influence against the bill, for they would regret the intrusion upon the Reservation of any structures or machinery that would tend to deface the scenery or introduce incongruous appliances within the limits of the State's property at Niagara.

Very respectfully yours.

ANDW. H. GREEN,

President Commissioners of the State Reservation at Niagara.

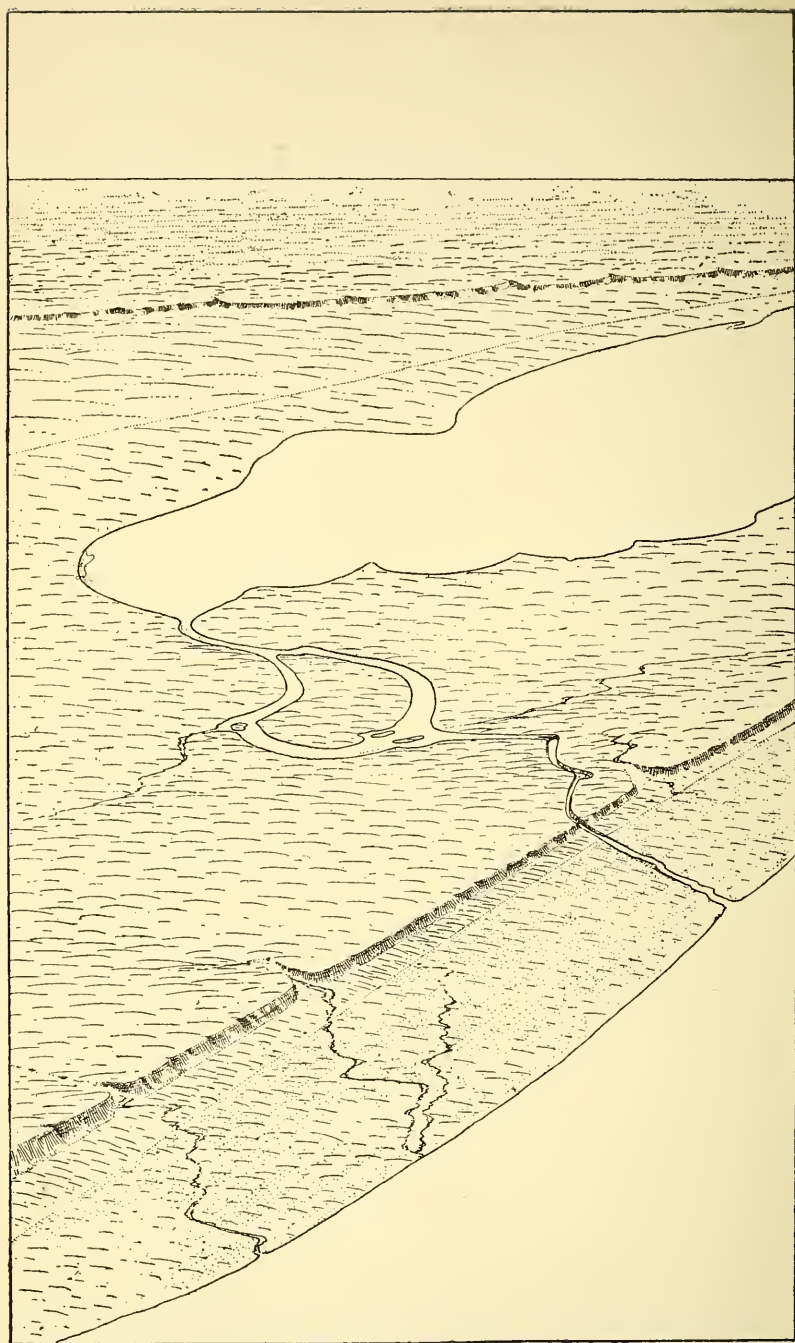


PLATE I.—Bird's-eye view of Niagara river.

THE HISTORY OF THE NIAGARA RIVER.¹

By G. K. GILBERT.

The Niagara river flows from Lake Erie to Lake Ontario. The shore of Erie is more than 300 feet higher than the shore of Ontario; but if you pass from the higher shore to the lower, you do not descend at a uniform rate. Starting from Lake Erie and going northward, you travel upon a plain—not level but with only gentle undulations—until you approach the shore of Lake Ontario, and then suddenly you find yourself on the brink of a high bluff or cliff overlooking the lower lake, and separated from it only by a narrow strip of sloping plain. The birds-eye view in Plate I is constructed to show the relations of these various features, the two lakes, the broad plateau lying a little higher than the shore of Lake Erie, the cliff, which geologists call the Niagara Escarpment, and the narrow plain at its foot.

Where the Niagara river leaves Lake Erie at Buffalo and enters the plain, a low ridge of rock crosses its path, and in traversing this its water is troubled; but it soon becomes smooth, spreads out broadly, and indolently loiters on the plain. For three-fourths of the distance it can not be said to have a valley, it rests upon the surface of the plateau; but then its habit suddenly changes. By the short rapid at Goat Island and by the cataract itself the water of the river is dropped 200 feet down into the plain, and thence to the cliff at Lewiston it races headlong through a deep and narrow gorge. From Lewiston to Lake Ontario there are no rapids. The river is again broad, and its channel is scored so deeply in the littoral plain that the current is relatively slow, and the level of its water surface varies but slightly from that of the lake.

The narrow gorge that contains the river from the Falls to Lewiston is a most peculiar and noteworthy feature. Its width

¹ This essay contains the substance of a lecture read to the American Association for the Advancement of Science at its Toronto meeting, August, 1889.

rarely equals the fourth of a mile, and its depth to the bottom of the river ranges from 200 to 500 feet. Its walls are so steep that opportunities for climbing up and down them are rare, and in these walls one may see the geologic structure of the plateau. They are constituted of bedded rocks—limestone, shale and sandstone—lying nearly horizontal, and a little examination shows that the same strata occur in the same order on both sides. So evenly are they matched, and so uniform is the general width of the gorge, that one might suspect, after a hasty examination, the two sides had been cleft asunder by some Plutonic agency. But those who have made a study of the subject have reached a different and better conclusion—the conclusion that the trench was excavated by running water, so that the strata of the two sides are alike because they are parts of continuous sheets, from each of which a narrow strip has here been cut.

The contour of the cataract is subject to change. From time to time blocks of rock break away, falling into the pool below, and new shapes are then given to the brink over which the water leaps. Many such falls of rock have taken place since the white man occupied the banks of the river, and the breaking away of a very large section is still a recent event. By such observation we are assured that the extent of the gorge is increasing at its end, that it is growing onger, and that the cataract is the cause of its extension.

This determination is the first element in the history of the river. A change is in progress before our eyes. The river's history, like human history, is being enacted, and from that which occurs we can draw inferences concerning what has occurred and what will occur. We can look forward to the time when the gorge now traversing the fourth part of the width of the plateau will completely divide it, so that the Niagara will drain Lake Erie to the bottom. We can look back to the time when there was no gorge, but when the water flowed on the top of the plain to its edge, and the Falls of Niagara were at Lewistown.

We may think of the river as laboring at a task—the task of sawing in two the plateau. The task is partly accomplished. When it is done the river will assume some other task. Before it was begun what did the river do?

How can we answer this question? The surplus water discharge from Lake Erie can not have flowed by this course to Lake Ontario without sawing at the plateau. Before it began the cutting of the gorge it did not flow along this line. It may have flowed somewhere else, but if so it did not constitute the Niagara river. The commencement of the cutting of the Niagara gorge is the beginning of the history of the Niagara river. We have accomplished somewhat of our purpose if we have discovered that our river had a beginning.

We are so accustomed to think of streams, and especially large streams, as permanent, as flowing on forever, that the discovery of a definite beginning to the life of a great river like the Niagara is important and impressive. But that discovery does not stand alone. Indeed, it is but one of a large class of similar facts familiar to students of geology. Let us consider for a moment the tendency of stream histories and the tendency of lake histories. Wherever streams fall over rocky ledges in rapids or in cataracts, their power of erosion is greatly increased by the rapid descent, and they deepen their channels. If this process continues long enough, the result must be that each stream will degrade its channel through the hard ledges until the descent is no more rapid there than in other parts of its course. It follows that a stream with cascades and water-falls and numerous rapids is laboring at an unfinished task. It is either a young stream, or else nature has recently put obstructions in its path.

Again, consider what occurs where a lake interrupts the course of a stream. The lower part of the stream, the outflowing part, by deepening its channel continually tends to drain the lake. The upper course, the inflowing stream, brings mud and sand with it and deposits them in the still water of the lake, thus tending to fill its basin. Thus, by a double process, the streams are laboring to extinguish the lakes that lie in their way, and given sufficient time, they will accomplish this. A stream whose course is interrupted by lakes is either a young stream, or else nature has recently put obstructions in its path.

Now if you will study a large map of North America, you will find that the region of the Great Lakes is likewise a region of small lakes. A multitude of lakes, lakelets, ponds and swamps

where ponds once were, characterize the surface from the Great Lakes northward to the Arctic ocean, and for a distance southward into the United States. In the same region water-falls abound, and many streams consist of mere alternations of rapids and pools. Farther south, in the region beyond the Ohio river, lakes and cataracts are rare. The majority of the streams flow from source to mouth with regulated course, their waters descending at first somewhat steeply, and gradually becoming more nearly level as they proceed. At the south the whole drainage system is mature; at the north it is immature. At the south it is old; at the north, young.

The explanation of this lies in a great geologic event of somewhat recent date—the event known as the age of ice. Previous to the ice age our streams may have been as tame and orderly as those of the Southern States, and we have no evidence that there were lakes in this region. During the ice age the region of the Great Lakes was somewhat in the condition of Greenland. It was covered by an immense sheet of ice and the ice was in motion. In general it moved from north to south. It carried with it whatever lay loose upon the surface. It did more than this, for just as the soft water of a stream, by dragging sand and pebbles over the bottom, wears its channel deeper, so the plastic ice, holding grains of sand and even large stones in its under surface, dragged these across the underlying rock, and in this way not only scoured and scratched it, but even wore it away.

In yet other ways the moving ice mass was analagous to a river. Its motion was perpetual, and its form changed little, but that which moved was continually renewed. As a river is supplied by rain; so the glacier was supplied by snow falling upon regions far to the north. To a certain extent the glacier discharged to the ocean like a river, breaking up into icebergs and floating away; but its chief discharge was upon the land, through melting. The climate at its southern margin was relatively warm, and into this warm climate the sheet of ice steadily pushed and was as steadily dissolved.

Whatever stones and earth were picked up or torn up by the ice, moved with it to its southern margin and fell to the ground as the ice melted. If the position of the ice margin had been perfectly

uniform, its continuously deposited load might have built a single high wall; but as the seasons were cold or warm, wet or dry, the ice margin advanced and retreated with endless variation, and this led to the deposition of irregular congeries of hills, constituting what is known as the "drift deposit." Eventually the warm climate of the south prevailed over the invader born of a cold climate, compelling it to retreat. The motion of the ice current was not reversed, but the front of the glacier was melted more rapidly than it could be renewed, and thus its area was gradually restricted. During the whole period of retrenchment, the deposition of drift proceeded at the margin of the ice, so that the entire area that it formerly occupied is now diversified by irregular sheets and heapings of earth and stone.

The ancient configuration of the country was more or less modified by the erosive action of the ice, and it was further modified by the deposits of drift. The destructive and constructive agencies together gave to the land an entirely new system of hills and valleys. When the ice was gone, the rain that fell on the land could no longer follow the old lines of drainage. Some of the old valleys had perhaps been obliterated; others had been changed so that their descent was in a different direction; and all were obstructed here and there by the heaps of drift. The waters were held upon the surface in innumerable lakes, each overflowing at the lowest side of its basin, and thus giving birth to a stream that descended to some other lake. Often the new lines of descent — the new water courses — crossed regions that before had had no streams, and then they were compelled to dig their own channels. Thus it was that the whole water system of a vast region was refashioned, and thus it has come to pass that the streams of this region are young.

Like every other stream of the district of the Great Lakes, the Niagara was born during the melting of the ice, and so we may begin our chronicle with the very beginning of the river.

If you will again call to mind the features of a general map of the United States and Canada, and consider the direction in which the streams flow, you will perceive that there is a continuous upland, a sort of main divide, separating the basin of the Great Lakes from the basin of the Mississippi. (A part of its course

appears as a broken line on the maps in Figures 3 and 4.) It is not a mountain range. In great part it is a region of hills. In places it is only the highest part of the plain. But it is nevertheless a continuous upland, else the waters would not be parted along its course. When the ice had its greatest extent, it passed over this upland, so that the waters produced by its melting fell into the Ohio and other tributaries of the Mississippi, as well as into streams that discharged to Delaware and Chesapeake bays. Afterward, when the glacier gradually fell back, there came a time when the ice front lay in the main to the north of the great water-parting, but had not yet receded from the Adirondack mountains, so that the water that flowed from the melting glacier could not escape by way of the St. Lawrence river, but gathered as a lake between the upland divide and the ice front. In fact it formed not one but many lakes, each discharging across the divide by some low pass; and as the great retreat progressed, these lakes were varied in number and extent, so that their full history is exceedingly complex.

The surfaces of these lakes were stirred by the winds, and waves beat upon their shores. In places they washed out the soft drift and carved cliffs; elsewhere they fashioned spits and bars. These cliffs and spits and other monuments of wave work survive to the present time, and have made it possible to trace out and map certain of the ancient lakes. The work of surveying them is barely begun, but from what is known we may add a chapter to the history of our river.

There was a time when one of these lakes occupied the western portion of the basin of Lake Erie, and discharged across the divide at the point where the city of Fort Wayne now stands, running into the Wabash river and thence into the Ohio. The channel of this discharge is so well preserved that its meaning can not be mistaken, and the associated shore-lines have been traced for many miles eastward into the Ohio, and northward into Michigan. Afterward, this lake found some other point of discharge, and a new shore-line was made twenty-five feet lower. Twice again the point of discharge was shifted, and other shore-lines were formed. The last and lowest of the series has been traced eastward across the States of Ohio and Pennsylvania and into western New York, where it fades away in the vicinity of the

town of Careyville. At each of the stages represented by these four shore-lines, the site of the Niagara was either buried beneath the ice or else submerged under the lake bordering the ice. There was no river.

The next change in the history of the lakes was a great one. The ice, which had previously occupied nearly the whole of the Ontario basin, so far withdrew as to enable the accumulated water to flow out by way of the Mohawk valley. The level of discharge was thus suddenly lowered 550 feet, and a large district previously submerged became dry land. Then for the first time Lake Erie and Lake Ontario were separated, and then for the first time the Niagara river carried the surplus water of Lake Erie to Lake Ontario.

The waves of the new-born Lake Ontario at once began to carve about its margin a record of its existence. That record is wonderfully clear, and the special training of the geologist has not been necessary to the recognition of its import. The earliest books of travel in western New York describe the Ridge road, and tell us that the ridge of sand and gravel which it follows was even then recognized by all residents as an ancient beach of the lake.¹ In the Province of Ontario the beach was examined and described by the great English geologist, Charles Lyell, during his celebrated journey in America,² and it afterward received more careful study by Mr. Sandford Fleming,³ and by the geologists of the Canadian Survey.⁴ In western New York it was traced out by the great American geologist, James Hall, during his survey of the geology of the fourth district of the State.⁵ Within a few years more attention has been given to detail. Professor J. W. Spencer has traced the line continuously from the head of the lake at Hamilton past Toronto, Windsor and Grafton to the vicinity of Belleville,⁶

1 C. Schultz, Jr.: Travels on an inland voyage * * * in the years 1807 and 1808, New York, 1810, p. 85.

De Witt Clinton: Discourse before the New York Historical Society, 1811, p. 58.

Francis Hall: Travels in Canada and the United States in 1816 and 1817, Boston, 1818, p. 119.

2 Travels in North America in the years 1841-2. New York, 1845. Vol. 2, pp. 86-87.

3 Sandford Fleming: Notes on the Davenport gravel drift. Canadian Journal, New Series, vol. 6, pp. 247-253.

4 Geological Survey of Canada, report to 1863, pp. 914-915.

5 Natural History of New York. Geology, Part IV, pp. 348-354.

6 Communicated to the Philosophical Society of Washington; to be published in Vol. 11 of the Bulletin of the Society.

beyond which point it is hard to follow. South of the lake, I myself have traced it from Hamilton to Queenston and Lewiston; thence to Rochester, and all about the eastern end of the basin to Watertown, beyond which point it is again difficult to trace. Southeast of the present margin of Lake Ontario, there was a great bay, extending as far south as Cayuga lake, and including the basin of Oneida lake, and it was from this bay that the discharge took place, the precise point of overflow being the present site of the city of Rome. For this predecessor of Lake Ontario Professor Spencer has proposed the name of Iroquois.

Putting together the results of his survey and of my own, I have been able to prepare a map (Pl. II) exhibiting with a fair amount of detail the outline of the old lake. It will be observed that the northeastern portion of the shore is not traced out. In fact it is not traceable. The water was contained on that side by the margin of the glacier, and with the final melting of the ice all record of its shore vanished.

The form and extent of Lake Iroquois, and the form and extent of each other lake that bordered the ice front, were determined partly by the position of the pass over which the discharge took place and by the contour of the land; but they were also determined to a great extent by the peculiar attitude of the land.

Perhaps a word of general explanation is necessary in speaking of the attitude of the land. Geologists are prone to talk of elevation and subsidence—of the uprising of the earth's crust at one place or at one time, and of its down-sinking at another place or another time. Their language usually seems to imply the rise or fall of an area all together, without any relative displacement of its parts; but you will readily see that, unless a rising or sinking tract is torn asunder from its surroundings, there must be all about it a belt in which the surface assumes an inclined position, or, in other words, where the attitude of the land is changed. If the district whose attitude changes is a lake basin, the change of attitude will cause a change in the position of the line marked about the slopes of the basin by the water margin, and it may even cause the overflow of the basin to take a new direction.

The Ontario basin has been subjected to a very notable change of attitude, and the effect of this change has been to throw the

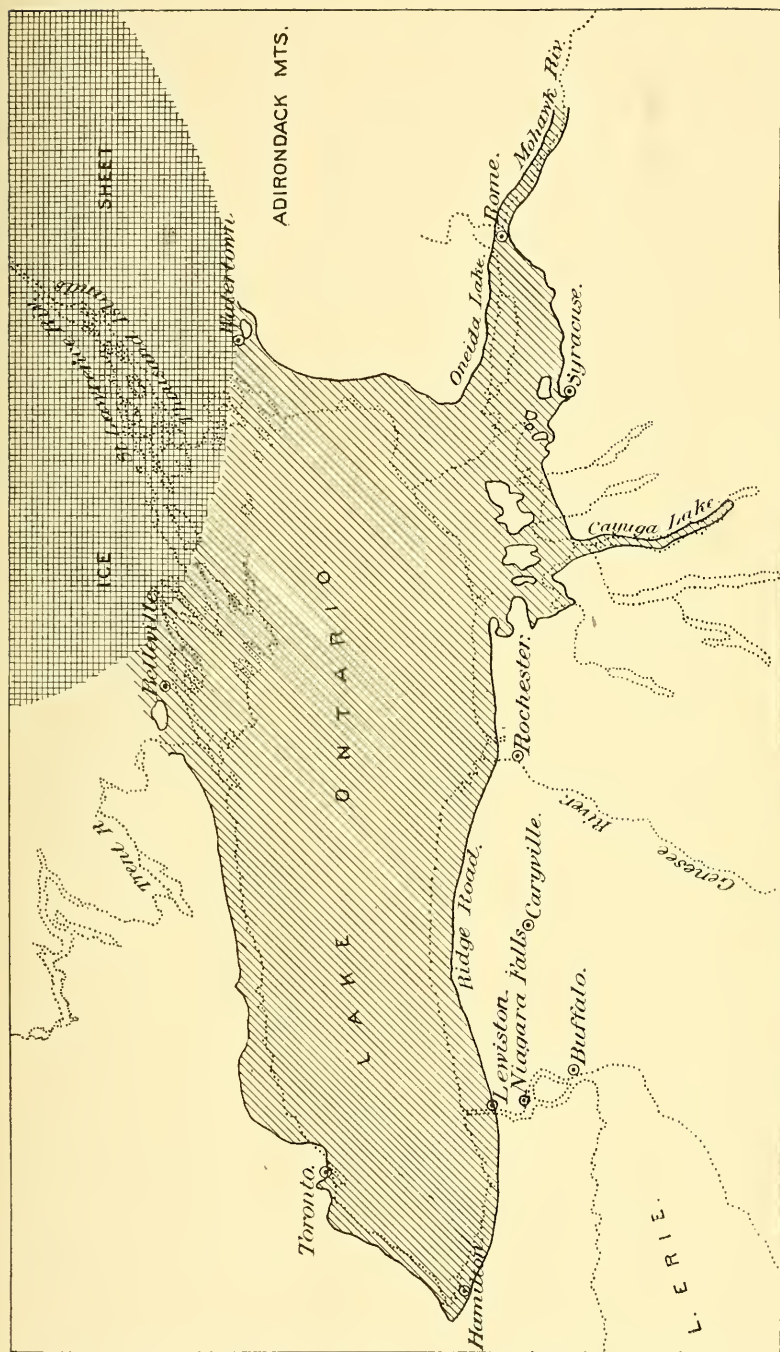


PLATE II.—Map of Lake Iroquois.

EXPLANATION.—Modern hydrography in dotted lines. Ancient lake area shaded. Ice sheet cross-shaded.

ancient shore-line out of level. When the shore-line was wrought by the waves, all parts of it must have lain in the same horizontal plane, and had there been no change in the attitude of the basin, every point of the shore-line would now be found at the level of the old outlet at Rome. Instead of this, we find that the old gravel spit near Toronto—the Davenport ridge—is forty feet higher than the contemporaneous gravel spit on which Lewiston is built; at Belleville, Ontario, the old shore is 200 feet higher than at Rochester, N. Y.; at Watertown 300 feet higher than at Syracuse; and the lowest point, in Hamilton, at the head of the lake, is 325 feet lower than the highest point near Watertown. From these and other measurements we learn that the Ontario basin with its new attitude inclines more to the south and west than with the old attitude.

The point of discharge remained at Rome as long as the ice was crowded high against the northern side of the Adirondack mountains, but eventually there came a time when the water escaped eastward between the ice and the mountain slope. The line of the St. Lawrence was not at once opened, so that the subsidence was only partial. The water was held for short times at various intermediate levels, recorded at the east in a series of faint shore-lines. Owing to the attitude of the land, these shores are not traceable all about the basin, but pass beneath the present water level at various points.

Finally the ice blockade was raised in the St. Lawrence valley, and the present outlet was established. During the period of final retreat the attitude of the land had slowly changed, so that it was not then so greatly depressed at the north as before; but it had not yet acquired its present position, and for a time Lake Ontario was smaller than now, its western margin lying lower down on the slope of the basin.

An attempt has been made in Pl. III to exhibit diagrammatically the relations of ice dams and basin attitudes to one another and to the river. The various elements are projected, with exaggeration of heights, on a vertical plane running a little west of south, or parallel to the direction of greatest inclination of old water-planes. At N is represented the Niagara escarpment and the associated slope of the lake basin; at A the Adirondack mountains. R and

There are the passes at Rome and at the Thousand Islands. Successive positions of the ice front are marked at I^1 , I^2 and I^3 . The straight line numbered 1 represents the level of lake water previous to the origin of the Niagara river; 2 gives the first position of the water level after the establishment of the Rome outlet; and the level gradually shifted to 3; 4 is the first of the series of temporary water levels when the water escaped between the mountain slope and the ice front; 5 represents the first position of the water level after the occupation of the Thousand Island outlet; and 6, the present level of Lake Ontario.

It should be added parenthetically that the shore of Lake Iroquois as mapped in Pl. II is not quite synchronous. Between 2 and 3 of Pl. III there was a continuous series of water levels, but it was not easy to map any one except the highest. The northern part of the map delineates the margin of water level 2, and the southern part the margin of water level 3.

It is easy to see that these various changes contribute to modify the history of the Niagara river. In the beginning, when the cataract was at Lewiston, the margin of Lake Ontario, instead of being seven miles away as now, was only one or two miles distant, and the level of its water was about seventy-five feet higher than at present. The outlet of the lake was at Rome, and while it there continued, there was a progressive change in the attitude of the land, causing the lake to rise at the mouth of the Niagara until it was 125 feet higher than now. It fairly washed the foot of the cliff at Queenston and Lewiston. Then came a time when the lake fell suddenly through a vertical distance of 250 feet, and its shore retreated to a position now submerged. Numerous minor oscillations were caused by successive shiftings of the point of discharge, and by progressive changes in the attitude of the land, until finally the present outlet was acquired, at which time the Niagara river had its greatest length. It then encroached five miles on the modern domain of Lake Ontario, and began a delta where now the lead-line runs out thirty fathoms.

While the level of discharge was lower than now, the river had different powers as an eroding agent. The rocks underlying the low plain along the margin of the lake are very soft, and where a river flows across yielding rocks, the depth to which it erodes is

limited chiefly by the level of its point of discharge. So when the point of discharge of the Niagara river—the surface of the lake to which it flowed—was from 100 to 200 feet lower than now, the river carved a channel far deeper than it could now carve. When afterward the rise of land in the vicinity of the outlet carried the water gradually up to its present position in the basin, this channel was partly filled by sand and other débris brought by the current; but it was not completely filled, and its remarkable present depth is one of the surviving witnesses of the shifting drama of the Ontario. Near Fort Niagara twelve fathoms of water are shown on the charts.

Mr. Warren Upham has made a similar discovery in the basin of the Red River of the North. That basin held a large lake, draining southward to the Mississippi—a lake whose association with the great glacier Upham appropriately signalized by naming it after the apostle of “the glacial theory,” Louis Agassiz. The height of the old Agassiz shore has been carefully measured by Mr. Upham, through long distances, and it is found to rise continuously, though not quite uniformly, toward the north. Similar discoveries have been made in the basins of Erie, Huron and Michigan, and the phenomena all belong approximately to the same epoch. So, while the details remain to be worked out, the general fact is already established that during the epoch of the ice retreat the great plain constituting the Laurentian basin was more inclined to the northward than at present.

It was shown, first in the case of Lake Agassiz, and afterward, as already stated, in the case of Lake Ontario, that the change from the old attitude of the land to the present attitude was in progress during the epoch of the ice retreat. The land was gradually rising to the north or northeast. In each lake basin the water either retreated from its northern margin, so as to lay bare more land, or encroached on its southern margin, or else both these changes occurred together; and in some cases we have reason to believe that the changes were so extensive that the outlets of lakes were shifted from northerly passes to more southerly passes.

To illustrate the effect of the earlier system of land slopes upon the distribution of water in the region of the Great Lakes, I have constructed the map in Pl. IV. It does not postulate the system

of levels most divergent from the present system, but a system such as may have existed at the point of time when the last glacial ice was melted from the region. The modern system of drainage is drawn in broken lines; the hypothetical system in full lines, with shading for the lake areas; and a heavier broken line toward the bottom of the map marks the position of the present water-parting at the southern edge of the Laurentian basin.

In the ancient system of drainage, Georgian bay, instead of being a dependency of Lake Huron, is itself the principal lake, and receives the overflow from Huron. It expands toward the northeast so as to include the basin of Lake Nipissing, and its discharge is across a somewhat low pass at the east end of Lake Nipissing, and thence down the Ottawa river to the St. Lawrence. Lake Michigan, instead of communicating with Lake Huron by a strait, forms a tributary lake, discharging its surplus through a river. Lake Superior has the same relations as now, but its overflow traverses a greater distance before reaching Lake Huron. Superior, Michigan, Huron and Georgia constitute a lake system by themselves, independent of Erie and Ontario, and the channel of the Detroit river is dry. Lake Erie and Lake Ontario, both greatly reduced in size, constitute another chain, but their connecting link, the Niagara river, is a comparatively small stream, for the diversion of the upper lakes robs the river of seven-eighths of its tributary area.

Whether this hypothetical state of drainage ever existed, whether the ice retreated from the Nipissing pass while still the changing attitude of the land was such as to turn the Georgian outlet in that direction, are questions not yet answered. But such data as I have at present incline me to the belief that for a time the upper lakes did discharge across the Nipissing pass.

Professor Spencer has described a channel by which Georgian bay once drained across a more southerly pass to the valley of the Trent river, and thence to Lake Ontario.¹ He states that there is an ancient shore-line about Georgian bay associated with this outlet, and that he has traced this line westward and southward until it comes down to the shore of Lake Huron, demonstrating that during the existence of that outlet also, the Detroit river ran

1 Proc. A. A. A. S., 37th Meeting (Cleveland), pp. 198-199.

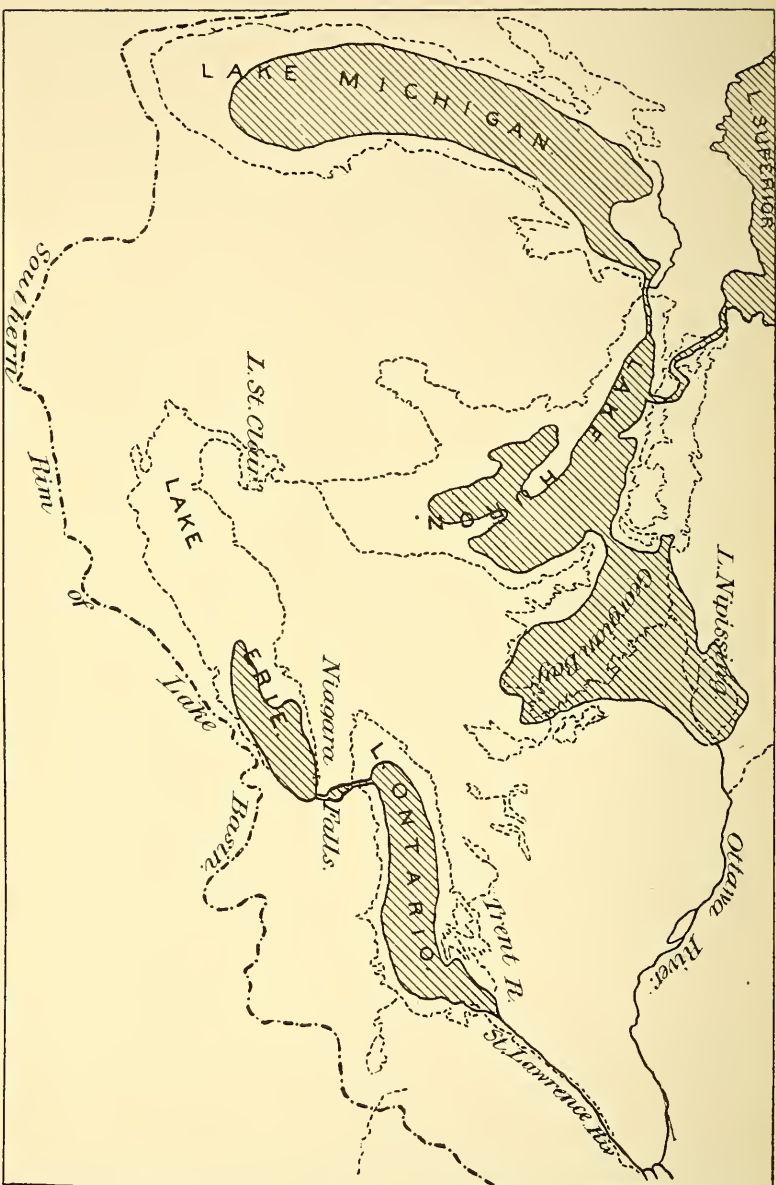


PLATE IV.—Hypothesized hydrography at a date after the melting of the great glacier from the St. Lawrence Valley.

EXPLANATION.—Water-parting in heavy broken line. Modern hydrography in light broken lines. Ancient rivers in full lines. Ancient lakes shaded.

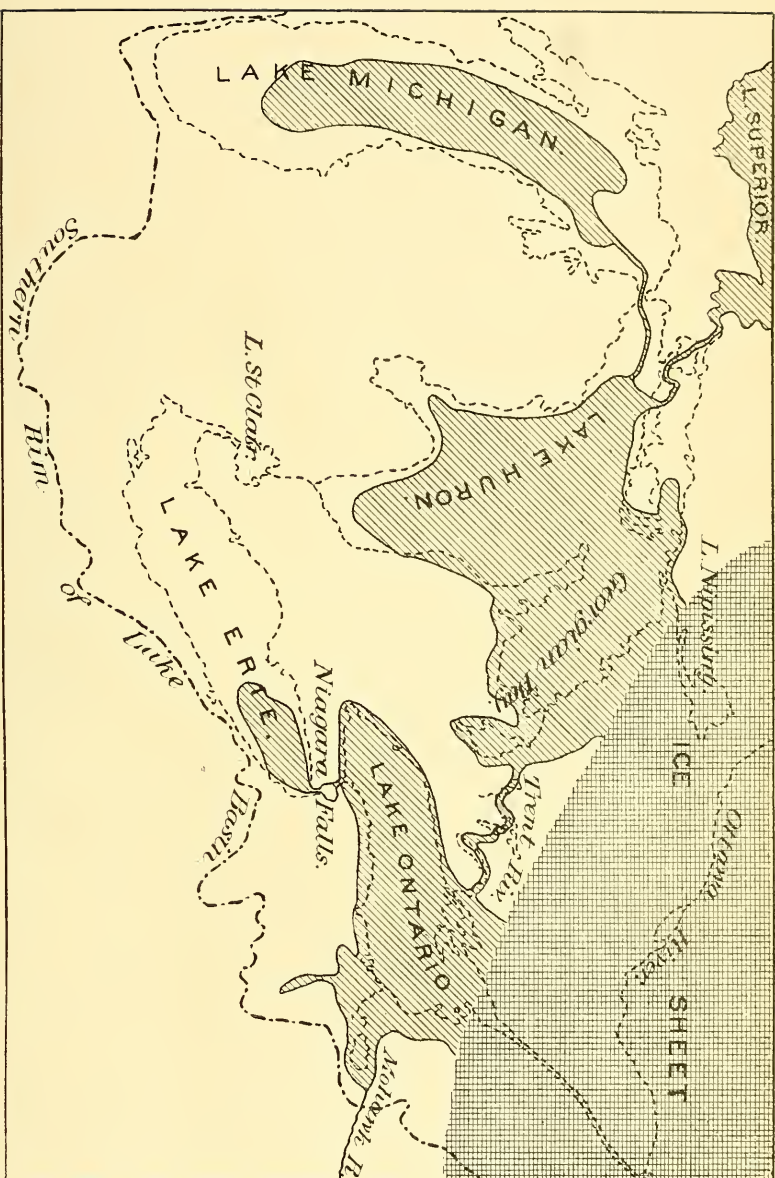


PLATE V.—Hypothetic hydrography at a date before the melting of the great glacier from the St. Lawrence Valley.

EXPLANATION.—Water-parting in heavy broken line. Modern hydrography in light broken lines. Ancient rivers in full lines. Ancient lakes shaded. Ice sheet cross-shaded.

dry. The Trent pass is much higher than the Nipissing pass, so that it appears necessary to assume that during the history of the Trent outlet for the upper lakes, the great glacier still occupied the region of Lake Nipissing, preventing the escape of the water in that direction.

The map in Pl. V represents the system of lakes and outlets at that time. It is largely theoretic, but at the same time I believe its general features consistent with our present knowledge of the facts.

Unless I have misunderstood Professor Spencer, Lake Ontario was at high stage in the first part of the epoch of the Trent valley outlet, and was afterward at low stage. I have selected as the date of my map the epoch of the high stage, with the outlet of Ontario at Rome, and have indicated an ice sheet so extensive as to block the way, not only at Lake Nipissing, but at the pass of the Thousand Islands. The date of this map is earlier than the other; it belongs to a time when the northward depression of the land was greater. Lake Erie is represented as less in extent, for its basin in that position would hold less water. Huron and Ontario would likewise be smaller were their waters free to escape over the lowest passes; but the ice blocks the way, and so their waters are raised to the level of higher passes. Of the contemporaneous relations of the upper lakes we know nothing at present. They are drawn as though communicating with Lake Huron, but it is equally possible that they fell into some other drainage system. Here again the Detroit channel was not in use, and the Niagara river was outlet only for the waters of the Erie basin.

Graphic methods are ill adapted to the communication of qualified or indefinite statements. By the aid of a map one can indicate definitely the relation of Albany to other places and things, but he can not say indefinitely that Albany is somewhere in eastern New York, nor can he say, with qualification, that it is probably on the Mohawk river. For this reason I have decided to publish these two maps only after hesitation, because I should greatly regret to produce the impression that the particular configuration of lakes and outlets here delineated has been actually demonstrated. The facts now at command are suggestive rather than conclusive, and when the subject shall have been fully investigated

it is to be expected that the maps representing these epochs will exhibit material differences from those I have drawn. The sole point that I wish to develop at this time is the probability that during a portion of the history of the Niagara river, its drainage district—that area from which its water was supplied—was far less than it is at the present time. There is reason to believe that during an epoch which may have been short or long, we can only vaguely conjecture, the Niagara was a comparatively small river.

The characters of the gorge are in general remarkably uniform from end to end. Its width does not vary greatly; its course is flexed but slightly; its walls exhibit the same alternation of soft and hard rocks. But there is one exceptional point. Midway, its course is abruptly bent at right angles. On the outside of the angle there is an enlargement of the gorge, and this enlargement contains a deep pool, called the Whirlpool. At this point, and on this side only, the material of the wall has an exceptional character. At every other point there is an alternation of shales, sandstones and limestones, capped above by an unequal deposit of drift. At this point, limestones, sandstones and shales disappear, and the whole wall is made of drift. Here is a place where the strata that floor the plateau are discontinuous, and must have been discontinuous before the last occupation of the region of the glacier, for the gap is filled by glacial drift.

Another physiographic feature was joined to this by Lyell and Hall. They observed that the cliff limiting the plateau has, in general, a very straight course, with few indentations. But at the town of St. Davids, a few miles west of Queenston, a wide flaring gap occurs. This gap is partly filled by drift, and although the glacial nature of the drift was not then understood, it was clearly perceived by those geologists that the drift-filled break marked the position of a line of erosion established before the period of the drift. Putting together the two anomalies, they said that the drift-filled gap at the Whirlpool belonged to the same line of ancient erosion with the drift-filled gap at St. Davids.¹ Their conclusion has been generally accepted by subsequent investigators, but the interpretation of the phenomena was carried little farther until

¹ *Travels in North America.* By Charles Lyell. New York, 1845. Vol. II, pp. 77-80.
Natural History of New York. Geology, Part IV. By James Hall, pp. 389-390.

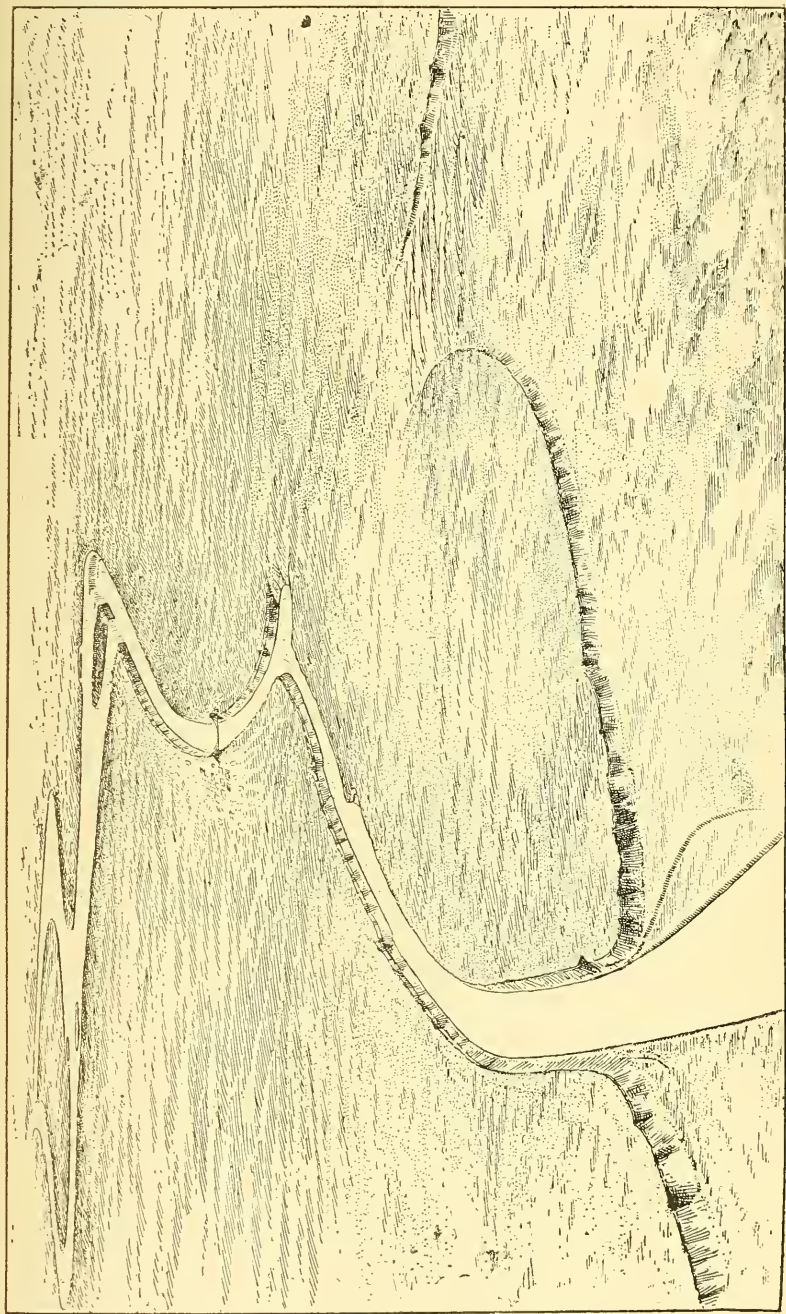


PLATE VI.—Bird's-eye view of the Niagara Gorge.

the subject was studied by Dr. Julius Pohlman.¹ He pointed out that the upper course of the ancient gorge could not have lain outside the modern gorge. If the course of one gorge lay athwart the course of the other, we should have two breaks in the continuity of the strata, instead of the single one at the Whirlpool. The upper part of the ancient gorge necessarily coincides with a part of the modern gorge; and so, when the cataract, in the progressive excavation of the canyon, reached a point at the Whirlpool where it had no firm rock to erode, it had only to clear out the incoherent earth and boulders of glacial drift. To whatever distance the gorge of the earlier stream extended, the modern river found its laborious task performed in advance.

Let us put together what we have learned of the Niagara history. The river began its existence during the final retreat of the great ice sheet, or, in other words, during the series of events that closed the age of ice in North America. If we consider as a geologic period the entire time that has elapsed since the beginning of the age of ice, then the history of the Niagara river covers only a portion of that period. In the judgment of most students of glacial geology, and, I may add, in my own judgment, it covers only a small portion of that period.

During the course of its history, the length of the river has suffered some variation by reason of the successive fall and rise of the level of Lake Ontario. It was at first a few miles shorter than now; then it became suddenly a few miles longer, and its present length was gradually acquired.

With the change in the position of its mouth there went a change in the height of its mouth; and the rate at which it eroded its channel was affected thereby. The influence on the rate of erosion was felt chiefly along the lower course of the river, between Lewiston and Fort Niagara.

The volume of the river has likewise been inconstant. In early days, when the lakes levied a large tribute on the melting glacier, the Niagara may have been a larger river than now; but there was a time when the discharge from the upper lakes avoided the route by Lake Erie, and then the Niagara was a relatively small stream.

1 Proc. A. A. A. S., 35th Meeting (Buffalo), pp. 221-222.

The great life work of the river has been the digging of the gorge through which it runs from the cataract to Lewiston. The beginning of its life was the beginning of that task. The length of the gorge is in some sense a measure of the river's age. In the main the material dug has been hard limestone and sandstone, interbedded with a coherent though softer shale; but for a part of the distance the material was incoherent drift.

The geologic age of the earth—the time during which its surface has been somewhat as now, divided into land and ocean, subject to endless waste on the land and to endless accumulation of sediment in the ocean, green with verdure and nourishing the varied forms of animal life—this time is of immense duration. Even the units into which geologists divide it, the periods and epochs of their chronology, are themselves of vast duration. Human history is relatively so short, and its units of centuries and years are so exceedingly brief, that the two orders of time are hardly commensurate. Over and over again the attempt has been made to link together the two chronologies, to obtain for the geologic units some satisfactory expression in the units of human history. It can not in fairness be said that all these attempts have failed, for some of them are novel and untested; but, however successful or unsuccessful they may have been, the interest in the subject remains, and no discussion of the history of the Niagara river would be complete without some allusion to its value as a geologic chronometer. It is true we know but little of the ratio the river epoch bears to the extent of the glacial period, or to any longer geologic unit; but yet were we able to determine, even approximately, the time consumed by the river in cutting its gorge, we should render less hazy and vague our conception of the order of magnitude of the units of the earth's geologic history. The problem has been attacked by numerous writers, and the resulting estimates have ranged from three or four thousand years to three or four million years.

The method of reaching a time estimate has been, first, to estimate the present rate of recession—the rate at which the cataract is increasing the length of the gorge; second, to compute, with the aid of this estimate and the known length of the gorge, the time necessary for the entire excavation; and, third, some

writers have modified their result by giving consideration to various conditions affecting the rate of erosion during earlier stages of the excavation. The enormous range of the resulting estimates of time has depended chiefly upon the imperfection of data with reference to the present rate of recession of the falls. It is but a few years since measurement of the rate of recession was substituted for bald guessing.

This measurement consists in making surveys and maps of the falls at different times, so that the amount of change in the interval between surveys can be ascertained by comparison of the maps. In 1842 Professor Hall made a survey of the outlines of the falls, and he published, for the use of future investigators, not only the map resulting from the survey, but also the bearings taken with the surveying instrument in determining the principal points of the map.¹ He likewise left upon the ground a number of well-marked monuments to which future surveys could be referred. Thirty-three years later a second survey was made by the United States Army Engineers, and they added still further to the series of bench marks available for future reference. Three years ago, my colleague, Mr. R. S. Woodward, executed a third survey.²

Plate VII exhibits the outline of the crest of the falls, together with the brink of the cliff in the vicinity of the falls, as determined by Mr. Woodward in 1886, and also shows a part of the same outline as determined by Professor Hall forty-four years earlier.³ If both were precise, the area included between the two lines would exactly represent the recession of the Horseshoe and American falls in forty-four years, and the retreat of the cliff face at Goat Island in the same time. I regret to say that there is internal evidence pointing to some defect in one or both surveys, for there are some points at which the Woodward outline projects farther towards the gorge than the Hall outline, and yet we can not believe that any additions have been made to the face of the cliff. Nevertheless, a critical study, not merely of these bare lines on the chart, but also of the fuller data in the surveyors' notes, leads to the belief that the rate of recession in the central part of the Horse-

1 Natural History of New York, Geology, Part IV, pp. 402-403.

2 Science, Vol. VIII, 1886, p. 205.

3 The south side of this chart is placed uppermost (in violation of the conventional rule) so that it may accord with the bird's-eye views.

shoe Fall is approximately determined, and that it is somewhere between four feet and six feet per annum. The amount fallen away at the sides of the Horseshoe is not well determined, but this is of less importance, for such falling away affects the width of the gorge rather than its length, and it is the length with which we are concerned.

The surveys likewise fail to afford any valuable estimate of the rate of retreat of the American Fall, merely telling us that its rate is far less than that of the Horseshoe—a result that might be reached independently by going back in imagination to the time when the two falls were together at the foot of Goat Island, and considering how much greater is the distance through which the Horseshoe Fall has since retreated. The rate of retreat of the central portion of the Horseshoe is the rate at which the gorge grows longer.

Now if we were to divide the entire length of the gorge by the space through which the Horseshoe Fall retreats in a year, we might regard the resulting quotient as expressing the number of years that the falls have been occupied with their work. This is precisely the procedure by which the majority of time estimates have been deduced, but in my judgment it is not defensible. It implies that the rate of retrogression has been uniform, or, more precisely, that the present rate of retrogression does not differ from the average rate, and this implication is open to serious question. I conceive that future progress in the discussion of the time problem will consist chiefly in determining in what ways the conditions or circumstances that affect the rate of retrogression have varied in past time. In order to discuss intelligently these conditions, it is necessary to understand just what is the process by which the river increases the length of its gorge.

There can be no question that the cataract is the efficient engine, but what kind of an engine is it? What is the principle on which it works?

It has already been stated that the rocks at the falls lie in level layers. The order of succession of the layers has much to do with the nature of the cataract's work. Above all is a loose sheet of drift, but this yields so readily to the wash of the water that we need pay no attention to it at present. Under that is a bed of strong

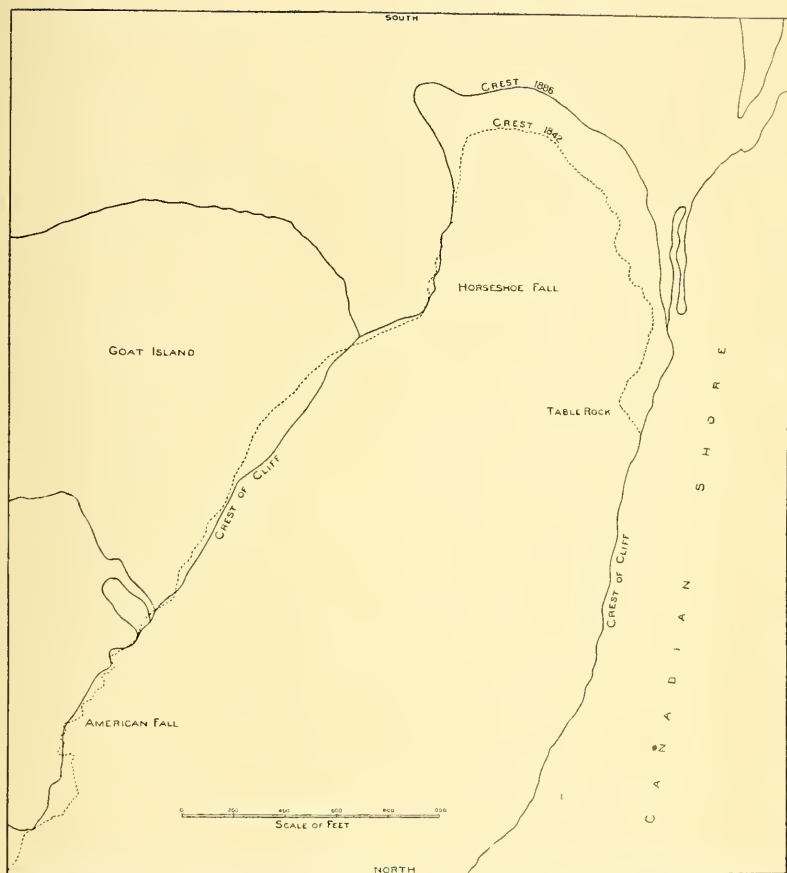


PLATE VII.—Chart of the Cliff Line at the head of the Niagara Gorge, compiled to show the Recession from 1842 to 1886.

EXPLANATION.— Broken line, crest of falls and cliff as mapped by N. Y. State Geol-Survey in 1842. Full line, crest of falls as mapped by the U. S. Geol. Survey in 1886, with other features as mapped by the U. S. Lake Survey in 1875.

limestone. This is called the Niagara limestone, and its thickness is eighty feet. Beneath it is a shale, called the Niagara shale, with a thickness of fifty feet; and then for thirty-five feet there is an alternation of limestone, shale and sandstone, known collectively as the Clinton group. This reaches down very nearly to the water's edge. Beneath it, and extending downward for several hundred feet, is a great bed of soft, sandy shale, interrupted, so far as we know, by but a single hard layer, a sandstone ledge, varying in thickness from ten to twenty feet. These are the Medina shales and the Medina sandstone. The profile in the figure indicates that the hard layers project as shelves or steps, and that the softer layers are eaten back. I have been led so to draw them by considerations of analogy only, for underneath the center of the great cataract no observations have been made. We only know that the river leaps from the upper surface of the Niagara limestone and strikes upon the water of the pool. The indicated depth of the pool, too, is a mere surmise, for in that commotion of waters direct observation is out of the question. But where the United States Engineers were able to lower their plummet, a half a mile away, a depth was discovered of nearly 200 feet, and I have assumed that the cataract is scouring as deeply now as it scoured at the time when that part of the gorge was dug.

It is a matter of direct observation that, from time to time, large blocks of the upper limestone fall away into the pool, and there seems no escape from the inference that this occurs because the erosion of the shale beneath deprives the limestone of its support. Just how the shale is eroded, and what is the part played by the harder layers beneath, are questions in regard to which we are much in doubt. In the Cave of the Winds, where one can pass beneath and behind one of the thinner segments of the divided fall, the air is filled with spray and heavier masses of water that perpetually dash against the shale, and though their force in that place does not seem to be violent, it is possible that their continual beating is the action that removes the shaly rock. The shale is of the variety known as calcareous, and as its calcareous element is soluble, it may be that solution plays its part in the work of undermining. What goes on beneath the water of the pool must be essentially different. The Niagara river carries no sedi-

ment, and therefore can not scour its channel in the manner of most rivers, but the fragments of the limestone bed that fall into the pool must be moved by the plunging water, else they would accumulate and impede its work; and being moved, we can understand that they become powerful agents of excavation. Water plunging into a pool acquires a gyratory motion, and, carrying detritus about with it, sometimes bores deep holes, even in rocks that are hard. These holes are called technically "pot-holes," and there is much to commend the suggestion that the excavation within the pool is essentially pot-hole work.¹

The process which I have described is that which takes place in the central part of the Horseshoe Fall, where the greatest body of water is precipitated. At the margin of the Horseshoe, and also at the American Fall, in which places the body of falling water is much less, the process is different. There is there no pot-hole action and no pool. The fallen blocks of limestone form a low talus at the foot of the cliff, and upon them the force of the descending water is broken and spent. Such of you as have made the excursion through the Cave of the Winds, will recall that though for a few steps you traveled upon an undisturbed rock stratum, one of the layers of the Clinton group, the greater part of the journey lay across large, fallen blocks of limestone, irregularly heaped. Where, then, the volume of falling water is relatively small, the great bed of shale below the Clinton ledges plays no part, and the rate at which the limestone breaks away is determined purely by the rate of erosion of the shale bed lying just beneath it.

The difference between the two processes is of great importance in the present connection, because the two rates of erosion are very different.

I am fully aware that this sketch of the cataract's work is not a satisfactory explanation of the mode of recession, but it yet serves a present purpose, for it renders it possible to point out that the rate of recession is affected by certain factors which may have varied during the earlier history of the river. We see that the process of recession is concerned with a heavy bed of hard rock

¹ I am indebted for this suggestion to Mr. W. J. McGee.

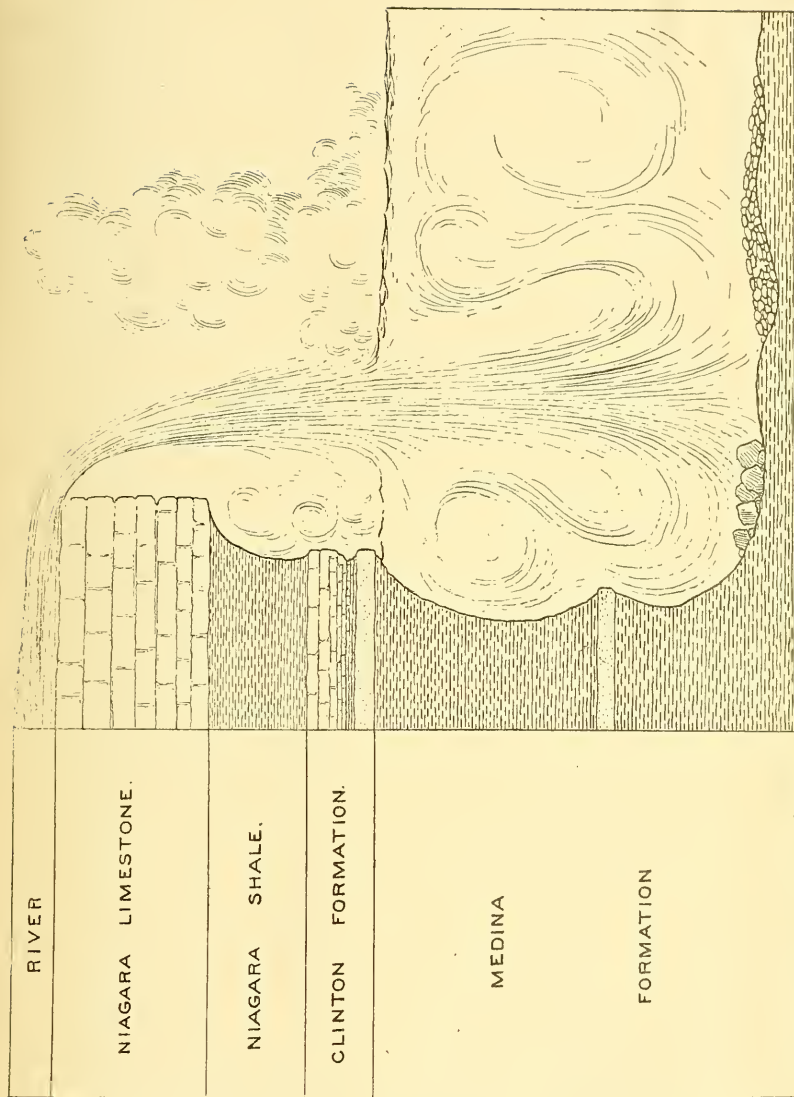


PLATE VIII.—Section of Niagara Falls, showing the arrangement of hard and soft strata, and illustrating a theory of the process of erosion.

above, with beds of softer rock beneath, with the force of falling water, and possibly, also, with the solvent power of the water.

Concerning each of these factors a number of pertinent questions may be asked, questions that should certainly be considered, whether they are answered or not, before any solution of the time problem is regarded as satisfactory. To illustrate their pertinence, a few will be propounded.

Question 1. Does the limestone vary in constitution in different parts of the gorge? If its texture or its system of cracks and joints varies, the process of recession may vary in consequence.

Question 2. How does the limestone bed vary in thickness in different parts of the gorge? This question is easily answered, for at all points it is well exposed for measurement.

Question 3. How is the thickness of the limestone related to the rate of recession? This is more difficult. The débris from a very thick bed of limestone would oppose great resistance to the cataract and check its work, The débris from a very thin bed would afford small and inefficient pestles for pot-hole action, and might lead to a slow rate of recession. If the thickness now seen at the cataract were slightly increased or slightly diminished, it is not at once apparent how the rate of recession would be affected, and yet there might be an important difference.

We have seen that the pre-glacial stream whose channel is betrayed at the Whirlpool, removed the Niagara limestone through a portion of the gorge, and

Question 4 asks: Through what portion of the gorge was the Niagara limestone absent when the Niagara river began its work?

Question 5. Does the rock section beneath the limestone — the shale series with its imbedded harder layers — does this vary in different parts of the gorge?

Question 6. Through what distance were the several members of the underlying rock series removed by the action of the pre-glacial stream?

Coming now to consider the force of the falling water, a little consideration serves to show that the force depends on at least three things: The height through which the water falls, the degree of concentration of the stream, and the volume of the river.

The height of the fall is the vertical distance from its crest to the surface of the pool below.

Question 7 asks: How has the height of the crest of the fall varied during the history of recession?

Question 8. How has the height of the base of the fall varied? And this involves a subsidiary question,—to what extent has the excavated gorge, as left by the retreating cataract, been refilled, either by the falling in of fragments from the cliffs, or by contributions of *débris* brought by the current?

Question 9. What has been the form of the channel at the crest of the fall, from point to point, during the recession? Wherever the channel has been broad, and the water of uniform depth from side to side, the force of the falling water has been applied disadvantageously; wherever the channel has been narrow, or has been much deeper in some parts than in others, the force of the water has been applied advantageously.

There are many ways in which it is possible that the volume of the river was made to differ at early dates from its present volume. During the presence of the ice, there was a different climate, and there were different drainage systems.

Question 10. During the early history of the river, was the annual rainfall on which its water supply depended greater or less than now?

Question 11. Was the evaporation from the basin at that time greater or less than now? It is believed that at the present time the Niagara river receives less than half the water that falls upon its basin in rain and snow, the remainder being returned to the air by evaporation from the lakes, from the surface of the land and from vegetation.

Question 12. Was the water supply increased by ablation? There may have been times when the overlapping edge of the glacier discharged to the Laurentian basin large bodies of water furnished by the melting of ice that had congealed from the clouds of regions far away.

Question 13. Was the drainage area of the river at any time increased through the agency of ice barriers? Just as the Winnipeg basin was made to send its water to the Mississippi, so we can imagine that regions north of the Great Lakes and now tributary

to Hudson's bay, had their discharge temporarily turned to Lake Superior and Lake Huron.

On the other hand, we have seen that the discharge of the whole district of the upper lakes was for a time turned away from the Niagara river. Therefore, we ask :

Question 14. To what extent and for what periods was the volume of the river diminished through the diversion of the discharge of the upper lakes?

Assuming all these questions to be answered one by one, and the variations of different sorts determined, it is still necessary to learn the relations of those variations to each other, and so we ask :

Question 15. How have the variations of rock section, the variations of cataract height, the variations of form of channel and the variations of volume been related to one another in point of time? What have been their actual combinations?

Question 16. How have the various temporary combinations of factors affected the process of retreat and the rate of recession.

The tale of questions is not exhausted, but no more are needed if only it has been shown that the subject is not in reality simple, as many have assumed, but highly complex. Some of the questions are, indeed, easily answered. It may be possible to show that others are of small moment. It may even be that careful study of the local features will enable the investigator to infer the process of cataract work at each point from the existing condition of the gorge, and thus relieve him from the necessity of considering such remote questions as the nature of glacial climate and the history of glacial retreat. But after all paring and pruning what remains of the problem will be no bagatelle. It is not to be solved by a few figures on a slate, nor yet by the writing of many essays. It is not to be solved by the cunning discussion of our scant, yet too puzzling knowledge—smoothing away inconvenient doubts with convenient assumptions, and cancelling out, as though compensatory, terms of unknown value that happen to stand on opposite sides of the equation. It is a problem of nature, and like other natural problems demands the patient gathering of many facts, of facts of many kinds, of categories of facts suggested by the ten-

tative theories of to-day, and of new categories of facts to be suggested by new theories.

I have said our problem is but the stepping stone to another problem, the discovery of common units for earth history and human history. The Niagara bridges the chasm in another way, or more strictly, in another sense, for the term of its life belongs to both histories. The river sprang from a great geologic revolution, the banishment of the dynasty of cold, and so its lifetime is a geologic epoch; but from first to last man has been the witness of its toil, and so its history is interwoven with the history of man. The human comrade of the river's youth was not, alas, a reporter with a note-book, else our present labor would be light. He has even told us little of himself. We only know that on a gravelly beach of Lake Iroquois, now the Ridge road, he rudely gathered stones to make a hearth, and built a fire; and the next storm breakers, forcing back the beach, buried and thus preserved, to gratify yet whet our curiosity, hearth, ashes and charred sticks.¹

In these Darwinian days, we can not deem primeval the man possessed of the Promethean art of fire, and so his presence on the scene adds zest to the pursuit of the Niagara problem. Whatever the antiquity of the great cataract may be found to be, the antiquity of man is greater.

1 American Anthropologist, Vol. II, pp. 173-174.

